

*The phonology-morphology  
interface in Malay:  
an optimality theoretic account*

*Pacific Linguistics*

**REFERENCE COPY**

**Not to be removed**

## Pacific Linguistics 568

Pacific Linguistics is a publisher specialising in grammars and linguistic descriptions, dictionaries and other materials on languages of the Pacific, Taiwan, the Philippines, Indonesia, East Timor, southeast and south Asia, and Australia.

Pacific Linguistics, established in 1963 through an initial grant from the Hunter Douglas Fund, is associated with the Research School of Pacific and Asian Studies at The Australian National University. The authors and editors of Pacific Linguistics publications are drawn from a wide range of institutions around the world. Publications are refereed by scholars with relevant expertise, who are usually not members of the editorial board.

---

FOUNDING EDITOR: Stephen A. Wurm

EDITORIAL BOARD: John Bowden, Malcolm Ross and Darrell Tryon (Managing Editors),  
I Wayan Arka, Jeffrey Marck, David Nash, Andrew Pawley, Paul  
Sidwell, Jane Simpson

---

### EDITORIAL ADVISORY BOARD:

Karen Adams, *Arizona State University*  
Peter Austin, *School of Oriental and African  
Studies*

Alexander Adelaar, *University of Melbourne*

Byron Bender, *University of Hawai'i*

Walter Bisang, *Johannes Gutenberg-  
Universität Mainz*

Robert Blust, *University of Hawai'i*

Lyle Campbell, *Canterbury University*

James Collins, *Universiti Kebangsaan  
Malaysia*

Bernard Comrie, *Max Planck Institute for  
Evolutionary Anthropology*

Soenjono Dardjowidjojo, *Universitas Atma  
Jaya*

Matthew Dryer, *State University of New York  
at Buffalo*

Jerold A. Edmondson, *University of Texas at  
Arlington*

Nicholas Evans, *University of Melbourne*

Margaret Florey, *Monash University*

William Foley, *University of Sydney*

Karl Franklin, *Summer Institute of Linguistics*

Charles Grimes, *Universitas Kristen Artha  
Wacana Kupang*

Nikolaus Himmelmann, *Ruhr-Universität  
Bochum*

Lillian Huang, *National Taiwan Normal  
University*

Bambang Kaswanti Purwo, *Universitas Atma  
Jaya*

Marian Klammer, *Universiteit Leiden*

Harold Koch, *Australian National University*

Frantisek Lichtenberk, *University of  
Auckland*

Patrick McConvell, *Australian Institute of  
Aboriginal and Torres Strait Islander  
Studies*

William McGregor, *Aarhus Universitet*

Ulrike Mosel, *Christian-Albrechts-  
Universität zu Kiel*

Claire Moyse-Faurie, *Centre National de la  
Recherche Scientifique*

Bernd Nothofer, *Johann Wolfgang Goethe-  
Universität Frankfurt am Main*

Ger Reesink, *Universiteit Leiden*

Lawrence Reid, *University of Hawai'i*

Jean-Claude Rivierre, *Centre National de la  
Recherche Scientifique*

Melenaite Taumoeofolau, *University of  
Auckland*

Tasaku Tsunoda, *University of Tokyo*

John Wolff, *Cornell University*

Elizabeth Zeitoun, *Academica Sinica*

# **The phonology-morphology interface in Malay: an optimality theoretic account**

**Zaharani Ahmad**



**Pacific Linguistics  
Research School of Pacific and Asian Studies  
The Australian National University**

Published by Pacific Linguistics  
Research School of Pacific and Asian Studies  
The Australian National University  
Canberra ACT 0200  
Australia

Copyright in this edition is vested with Pacific Linguistics.

First published 2005

National Library of Australia Cataloguing-in-Publication entry:

Zaharani Ahmad

The phonology–morphology interface in Malay: an optimality theoretic account

Bibliography.  
ISBN 0 85883 555 X

1. Malay language – Morphology. 2. Malay language – Phonology.  
I. The Australian National University. Research School of Pacific and  
Asian Studies. II. Title.

499.28

Copyedited by Laura Daniliuc  
Typeset by Jeanette Coombes  
Cover design by Cirils Printers  
Printed Cirils Printers, Fyshwick, Canberra



***Dedicated to  
my wife Nor Hashimah and my daughters  
Nor Amira, Nor Amalina, Nor Ltyana,  
Nor Farhain and Nor Matsarah  
with love and thanks.***



# *Table of contents*

---

<i>Preface</i>	ix
<b>Chapter 1: Introduction</b>	1
1.1 Introduction	1
1.2 A brief note on the language	1
1.3 Statement of the problem	5
1.4 Review of previous studies	6
1.5 Data and methodology	8
1.6 Purpose and scope of this study	8
1.7 Theoretical background	9
1.8 Structure of this book	13
<b>Chapter 2: Syllable structure and syllabification</b>	15
2.1 Introduction	15
2.2 Basic syllable structure and syllabification	16
2.3 ONSET satisfaction: vowel sequences and the syllabification of high vowels	22
2.3.1 Postvocalic high vowel	25
2.3.2 Intervocalic high vowel	26
2.3.3 Prevocalic high vowel	30
2.3.4 Previous accounts	32
2.4 ONSET violation: ALIGN-LEFT and CONTIGUITY	40
2.5 Syllable structure: CODA COND	49
2.5.1 ALIGN-STOP(K): Debuccalisation	51
2.5.2 ALIGN-OBST: Obstruent Devoicing	55
2.5.3 ALIGN-RHOTIC: r-Deletion	58
2.5.4 ALIGN-NASAL: Nasal Assimilation	63
2.6 Mid-vowels in closed final syllables	67
2.7 Conclusion	71
<b>Chapter 3: The phonology-morphology interface in suffixation</b>	73
3.1 Introduction	73
3.2 ALIGN-RIGHT and ONSET interaction	73

3.2.1	Glottal Epenthesis and V-Gemination	74
3.2.2	C-Gemination	83
3.3	ALIGN-RIGHT and CODA COND interaction	85
3.3.1	ALIGN-STOP(K) satisfaction: Debuccalisation	86
3.3.2	ALIGN-RHOTIC satisfaction: r-Gemination, r-Deletion and compensatory lengthening	92
3.3.3	ALIGN-NASAL violation: opacity of Nasal Assimilation and Nasal Coalescence	96
3.4	Vowel Debuccalisation	
3.5	Conclusion	105
<b>Chapter 4:</b>	<b>The phonology-morphology interface in prefixation</b>	<b>106</b>
4.1	Introduction	106
4.2	ONSET satisfaction: Glottal Epenthesis and Resyllabification	107
4.3	ALIGN-NASAL satisfaction: Nasal Assimilation and Nasal Deletion	115
4.4	OCP effects: Nasal Deletion	119
4.5	*NÇ effects: Nasal Coalescence	123
4.6	ALIGN-RHOTIC satisfaction: r-deletion without compensatory lengthening	130
4.7	Vowel Nasalisation	132
4.8	Conclusion	136
<b>Chapter 5:</b>	<b>The phonology-morphology interface in reduplication</b>	<b>137</b>
5.1	Introduction	137
5.2	Reduplication in Correspondence Theory	138
5.2.1	The Model	139
5.3	Malay Reduplication: an overview	141
5.4	The phonology-morphology interface in Root Reduplication	143
5.4.1	Overapplication	150
5.4.1.1	Overapplication base to reduplicant: Nasal Coalescence	151
5.4.1.2	Overapplication reduplicant to base: r-Deletion and Vowel Debuccalisation	155
5.4.1.3	Interactional overapplication: Vowel Nasalisation	157
5.4.1.4	Previous account: a Global Theoretic approach	159
5.4.1.5	Over-copying of final-prefix C	161
5.4.2	Normal application: Nasal Harmony	168
5.4.3	Underapplication: r-Deletion	174
5.5	Conclusion	178
<b>Chapter 6:</b>	<b>Conclusion</b>	<b>180</b>
6.1	Conclusion	180
6.2	Concluding remarks	182
6.2.1	Partial reduplication	182
6.2.2	Nasal Coalescence	184
<i>References</i>		186

# *Preface*

---

This book gives an exhaustive description of the phonology and the interface between the phonology and the morphology of the Malay language. The description primarily focuses on the segmental alternations that are derived due the morphological processes of prefixation, suffixation and reduplication. It is observed that the phonology of prefixation, suffixation and reduplication in the language are quite distinct in both character and degree of generality. Processes that are visibly active in prefixation are generally not active in suffixation or reduplication, and vice versa. This asymmetry has not been satisfactorily accounted for in previous works.

The phonological analysis proposed in this book is grounded in the theoretical framework of Correspondence Theory (McCarthy & Prince 1995b), set within the constraint-based approach of Optimality Theory (Prince & Smolensky 1993). The asymmetry between prefixation, suffixation and reduplication is satisfactorily accounted for as a consequence of the output candidate best satisfying the language's constraint hierarchy.

The book is organised into six chapters. Chapter 1 gives a brief overview of the language under investigation, and briefly introduces some fundamental aspects of Optimality Theory. Chapter 2 examines the aspects of Malay phonology which are governed and conditioned by syllable structure and syllabification.

Chapters 3 and 4 investigate the phonology and morphology interface in suffixation and prefixation respectively. It is apparent that the morphophonological behaviour of suffixation is quite distinct from prefixation both in character and in degree of generality. The asymmetry between prefixation and suffixation is accounted for as a consequence of the output candidate best satisfying the language's constraint hierarchy.

The interaction between phonology and reduplication, which gives rise to a variety of reduplicative patterns, is examined in Chapter 5. It is demonstrated that these reduplicative phenomena can be accounted for and regulated by a single language-specific ranking schema. The parallelist Correspondence Theory provides a unified framework to capture the generalisation that fundamentally a single general ranking schema is at work in driving all of those reduplicative patterns. Finally, Chapter 6 gives a brief summary of the important findings discussed thus far.

This book is based on my dissertation 'The phonology and morphology interface in Malay: an optimality theoretic account', which was submitted to the Department of Language and Linguistics, University of Essex, United Kingdom, for the degree of Doctor of Philosophy in Language and Linguistics in March 1998.

My achievement in completing this book was due largely to the support and contribution of many generous and considerate people to whom I owe deep gratitude. My greatest appreciation goes to Professor Iggy Roca, my adviser, who gave me immeasurable assistance

and encouragement and provided me with penetrating criticism and suggestions throughout the preparation of the book.

I am sincerely grateful to my colleagues at Essex University Phonology Workshop who have provided helpful discussions and suggestions, especially Russell Norton, Nick Sherrard, Faisal Al-Mohanna, Chen Shu Ming, Dr Wyn Johnson, Paula M. Reimers, Hussein M. Al-Ageli, Hiroyuki Maeda and Lahcen Damiri.

I would like to extend my heartfelt thanks to my wife, Nor Hashimah, and my lovely daughters, Nor Amira, Nor Amalina, Nor Liyana, Nor Farhain and Nor Maisarah for their enduring love, support and patience, without which the successful completion of this dissertation would not have been possible.

I would also like to thank the Universiti Kebangsaan Malaysia (National University of Malaysia) for awarding me the scholarship and the study leave to pursue my postgraduate studies at the University of Essex.

Last but not least, I am also sincerely thankful to my father, Ahmad, my mother, Habibah, and my mother-in-law, Halimah, for their prayers, love and encouragement.

*Zaharani Ahmad*  
Bengi, Selangor  
Malaysia  
2005

# 1 *Introduction*

---

## 1.1 Introduction

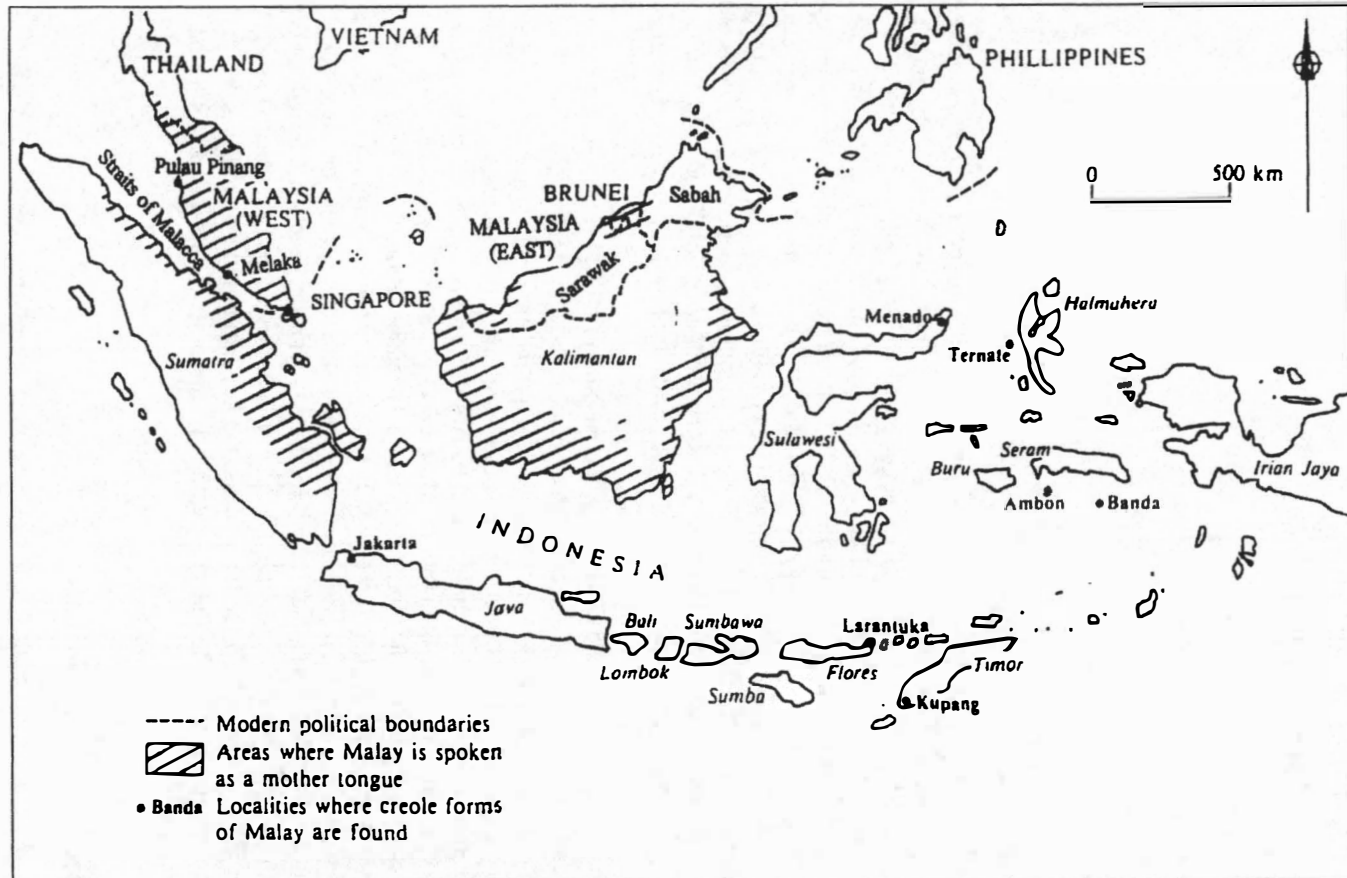
Current work in phonology is witnessing a substantial paradigm shift. The formalisation and the explanatory burden of linguistic generalisation have now been largely or entirely shifted from input-based rewrite rules to output-based well-formedness constraint. Works with such approach are Government Phonology (Kaye, Lowenstamm & Vergnaud 1985), Constraint and Repair Strategies (Paradis 1988), Constraint-Based Phonology (Bird 1990; Scobbie 1992), Harmonic Phonology: (Goldsmith 1993), Cognitive Phonology (Lakoff 1993), Optimality Theory (Prince & Smolensky 1993), and Two-Level Phonology (Koskeniemi 1983; Karttunen 1993). One of the most prominent constraint-based approaches in recent literature is Optimality Theory propounded by Prince and Smolensky (1993). Optimality Theory represents a new perspective on how a grammar is constructed, most notably its phonology.

With the advent of Optimality Theory, numerous analyses of phenomena cast under the conventional rule-based approach have been reexamined and reanalysed. The result is illuminating, as linguistic generalisations can be captured more adequately and elegantly under the new approach. Furthermore, phenomena which are problematic and difficult under rule theory can now be handled quite straightforwardly. In keeping with current work in phonology, the present study attempts to offer an Optimality Theoretic account on the interface between phonology and morphology in Malay reduplication.

This chapter is organised as follows. Section 1.2 gives a brief overview of the language under investigation. Section 1.3 outlines briefly the statement of the problem and §1.4 reviews some substantial works that have been done previously. Section 1.5 highlights the purposes and scope of the present study. In §1.6, I introduce some fundamental aspects of Optimality Theory, particularly the basic ideas, the key assumptions, and the notation that underlie the architecture of the theory. Section 1.7 presents the overall structure of this dissertation.

## 1.2 A brief note on the language

*Bahasa Melayu* or the Malay language is a member of the Western Branch of the Malayo-Polynesian family, which is one of the branches of the Austronesian family. As shown in Map 1, the native speakers of the language are mainly concentrated in the area of



**Map 1:** Areas where Malay has been spoken as a mother tongue.  
(Adapted from Prentice (1987:914))



the Malacca Straits. In the early days, this route was a very strategic location through which the extensive maritime trade between India and Arabia in the west and China in the east had to pass. The monsoon pattern here made it impossible to complete the voyage without having a pause for some months in the Malay-speaking area. This geographical factor resulted in Malay eventually serving as a lingua franca throughout the Southeast Asia region. It has been reported that when the earliest Europeans arrived in the Indonesian archipelago, they found Malay already in widespread use in that region (Prentice 1987).

Today Malay is the national language of four of the Southeast Asia countries, spoken by an estimated 180 million people: the Republic of Indonesia (160 million), the Federation of Malaysia (15 million), the Republic of Singapore (3 million) and the Sultanate of Brunei (0.25 million) (Prentice 1987). Unlike the other nation states, the Republic of Indonesia has given the language a new name, officially termed *Bahasa Indonesia* or the Indonesian language, which is inspired by political and national aspirations.<sup>1</sup> The renaming of *Bahasa Melayu* as *Bahasa Indonesia* was solemnly proclaimed by young nationalists in the famous declaration of *Sumpah Pemuda* (or the youth oath) in 28<sup>th</sup> October 1928, as part of their fight for independence.

Despite being widely spoken, Malay is by no means the mother tongue of the majority of the Indonesians. It is estimated that only 7% of the total population speak Malay as their first language, and 93% as a second language which is formally learned in schools (Prentice 1987). Indonesia has many Austronesian languages which are spoken as a first language. After Indonesian, the most important language of the whole region is Javanese (60 million speakers in central and eastern Java), followed by Sundanese (20 million speakers in western Java). The other important languages spoken by more than one million speakers are Achinese (northernmost Sumatra), Batak (north-central Sumatra), Minangkabau (south-west Sumatra), Buginese, Makassarese (both in southern Celebes), Madurese (Madura and eastern Java), and Balinese (Bali) (Prentice 1987).

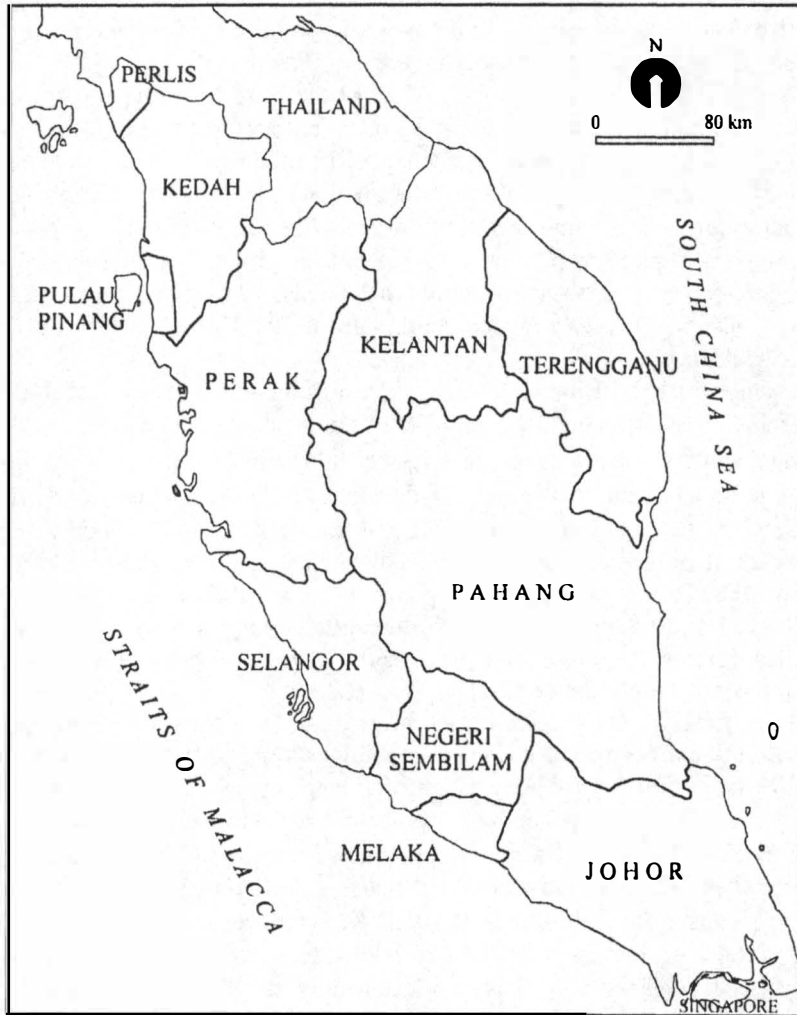
In Malaysia, Malay is the mother tongue of about 45% of the total population (Prentice 1987). Most of them are found in Peninsula Malaysia and the coastlands of Sabah and Sarawak. The other 55% learn Malay as a second language in schools and universities. The languages which are natively spoken by this group are as follows: Chinese languages (mainly Cantonese, Hakka, Hokkien, Hainanese, Teochew, Fuchow), Indian languages (Tamil, Malayalam, Telugu, Punjabi), Austronesian languages (native to Sabah and Sarawak: Iban, Land Dayak, Melanau, Bisayah, Murut, Bidayuh, Kadazan, etc.).

Like any other natural language, Malay is characterised by the presence of various dialects or varieties, regional as well as social. Generally, the division of the Malay language into regional dialects seems to coincide with the division of Malaysia into various states (cf. Asmah 1993). Thus, there are dialects known as Johore Malay, Kedah Malay, Perak Malay, Kelantan Malay and so on (see Map 2).

It has been traditionally considered that the Johore-Riau Malay which is predominantly spoken in the southern part of the Malay peninsula is the standard dialect of Malay. This presumption is based on the historical fact that this was the standard language of the Johore empire in the seventeenth century, which covered the states of Terengganu, Pahang, Johore and Riau Archipelago. It is said that the manuscript called *Sejarah Melayu*, translated as

<sup>1</sup> Under the same consideration, in the early seventies, following the communal riot of 1969, the Malaysian government designated the term *Bahasa Malaysia* (the Malaysian language) to supersede *Bahasa Melayu*. It replaced English and became the sole medium of instruction in schools, with the intention of uniting an ethnically divided society in the region. However, this did not last long. In the late eighties, the term *Bahasa Melayu* regained its status as the designated term for the Malay language.

The Malay Annals, was written during this period. The preference of Johore-Riau Malay as the standard dialect of Malay is further supported by the fact that it is morphologically and syntactically closer to literary Malay, than to other Malay dialects (cf. Farid 1980; Asmah 1975).



**Map 2:** Malay dialects in Peninsula (West) Malaysia  
(Adapted from Asmah (1993:129))

It has long been observed that there are some minor differences between literary Malay and the standard dialect of Malay. First, orthographic <a> in word final position corresponds to a low back vowel [a] in literary Malay, while in the standard dialect it is realised as a schwa, [ə]. Due to this particular feature, this dialect is also commonly referred to as the schwa-variety (Asmah 1977). Second, orthographic <r> is pronounced as a flap [ɾ] word initially and medially in literary Malay, whereas in the standard dialect it is generally pronounced as a velar fricative [ɣ] (see §2.5.3 for a more precise description). Third, <r> is never pronounced in syllable coda position in the standard dialect, except root internally,

while in literary Malay this segment is always retained. Fourth, orthographic <i, u> in stem closed final syllables correspond to the high vowels [i, u] in literary Malay, whereas in the standard dialect they are realised as mid vowels [e, o]. Apart from these facts, there seems to exist some degree of uniformity and consistency between the two varieties.

In a recent development, the *Dewan Bahasa dan Pustaka* (The government Language Planning Agency) has ruled that the '*sebutan baku Bahasa Melayu*', translated as the standard pronunciation of Malay, must be based on literary Malay. This requires that the word must be pronounced more in accordance with its orthographic representation. From a linguistic point of view, such a stance is purely prescriptive. As is well known, linguistics is a descriptive discipline, not a prescriptive one. Thus, for the purposes of the present study, I consider the schwa-variety or the Johore-Riau Malay as the dialect most representative of contemporary standard Malay pronunciation, and not the prescriptive variety that is associated with literary Malay.

### 1.3 Statement of the problem

In current theories of phonology and morphology, in particular Prosodic Morphology (McCarthy & Prince 1986 *et seq.*), reduplication is essentially considered part of affixational morphology. Unlike ordinary affixes, the reduplicative affix is phonologically unspecified, receiving its phonemic content through copying the melodic material of the base. The goal of Prosodic Morphology, as argued in McCarthy and Prince (1995b), is to derive the properties of reduplication and kindred phenomena from general principles of phonology and morphology, reducing and ultimately eliminating the principles that are specific just to reduplication. Thus, the regularities of reduplication and similar phenomena should be derived from (i) general properties of phonology, (ii) general properties of morphology, and (iii) general properties of the interface between phonology and morphology.

As far as Malay reduplication is concerned, the aspects (i) and (iii) have been underdescribed and understudied. This is arguably because, unlike ordinary affixation, reduplication is associated with a lot of apparently exceptional phonological behaviour, which are very difficult, if not impossible, to capture under the traditional rule-based analysis.

Farid's (1976) PhD dissertation, published in 1980, remains the most comprehensive research to date on aspects of Malay phonology and morphology. In addition to prefixation and suffixation, he examines the phonological aspects of reduplication quite extensively. Farid's analysis of reduplication is couched in the standard linear rule-based approach of Wilbur's (1973a) Global Theory.

With the advent of multilinear phonology, Farid's work was re-examined and reanalysed in Teoh's (1988) PhD dissertation, published by Dewan Bahasa dan Pustaka in 1994. Given the insights afforded by multilinear phonology, Teoh argued that the new analysis is superior and more adequate, and that its account fulfils the requirements of descriptive, observational and explanatory adequacy. Nevertheless, the superiority of the non-linear analysis over the linear one was not been demonstrated in the domain of reduplication, which was disregarded in Teoh's work. Thus, Farid's linear account of the phonology of reduplication remains to date unchallenged.

As argued in the literature, the interaction between phonology and morphology in reduplication gives rise to reduplicative patterns which are commonly dubbed overapplication, underapplication and normal application (Wilbur 1973; Marantz 1982; Carrier 1979; McCarthy & Prince 1995). Overapplication refers to the case in which both the base and the reduplicant undergo the same phonological alternation, although the regular

triggering condition is found in just one of them (i.e. /məŋ+ tari/ → [mənari-nari]). It is examined quite extensively in Farid (1980).

Remarkably, two other reduplicative patterns which are well attested in the language are overlooked by him. These are underapplication — where a regular phonological effect fails to apply to the base or the reduplicant when the relevant environment is found only in one or the other — and normal application — where both the base and the reduplicant are phonologically well-behaved, as the rule in Farid's term applies whenever its environment is satisfied.

Interestingly, over-, under- and normal application can be triggered by a single phonological rule. In other words, the same phonological rule in Farid's term can apply in three different reduplicative modes. This situation is very difficult, if not impossible, to account for under the Global Theoretic approach, and therefore the account in Farid (1980) is descriptively and explanatorily inadequate. Descriptively, it fails to account for how the same rule can overapply in some environments, and either normally apply or underapply in others. Explanatorily, it cannot spell out the conditions that determine such different reduplicative effects.

In addition to reduplication, phonological irregularities, more specifically phonological opacities do occur in suffixation and root internal domains. This fact has not been satisfactorily explained in previous studies. Even worse, the generalisations have simply been overlooked or misinterpreted.

It has been observed that the suffix boundary is opaque to visibly active effects such as Nasal Assimilation and Nasal Coalescence. Since no plausible solution can be offered under the rule-based analysis, this peculiar behaviour has been treated as an exception (cf. Farid 1980). It is also observable that regular effects such as Nasal Deletion, r-Deletion, Glottal Epenthesis are inapplicable root internally. This fact, however, is either overlooked or misinterpreted in Farid (1980) and Teoh (1994).

In conclusion, the phonology of reduplication, suffixation and root in Malay is faced with certain apparent phonological irregularities. These phenomena have not been satisfactorily captured and accounted for in the previous studies. The irregular behaviour is treated either as an exception or the facts are either simply overlooked or else misconstrued.

## 1.4 Review of previous studies

Malay reduplication has been studied by many linguistic investigators. Most of them approach reduplication from the perspective of morphology. Thus, their descriptions are basically focused on the classification of forms, grammatical functions and meanings of these reduplicative words. Some substantial works are Abdullah (1974, 1986), Asmah (1975), Nik Safiah, Farid and Hashim (1989) and Hashim (1993). It must be mentioned that there are also some substantial works on the phonology and morphology of the dialects of Malay, most of which are published and unpublished theses and dissertations. Among the most informative sources are Zainal (1964), Hendon (1966), Zahara (1966), Musa (1974) and Zaharani (1991).

Although some aspects of phonology are briefly discussed in Abdullah (1974) and Hashim (1993), the rules they discuss are only applicable to ordinary affixations, such as prefixation and suffixation. The effects of phonological rules on reduplication have not been precisely discussed and explained. This aspect has not been seriously studied, arguably because reduplication is not considered a part of affixational morphology, and because it is not subject to the regular phonology.

Concerning Malay phonology, some substantial works that are cited in the literature are Yunus (1980), Farid (1980) and Teoh (1994). Yunus (1980) is in the old taxonomic framework. His description focuses mainly on the inventories and distributions of phonological segments. Yunus (1980:2, 51) claims that the Malay phonemic inventory consists of 6 vowels — /i, u, e, o, ə, a/ and 19 consonants — /p, b, t, d, ʈ, ʄ, k, g, ʔ, s, h, m, n, ɲ, ɳ, l, r, y, w/. Each segment is provided with a brief articulatory description and its distribution within words is exemplified in three different environments, namely word initially, medially and finally.

Yunus also discusses the syllable briefly and affirms that Malay is a language with a (C)V(C) syllable structure. He observes that most of the roots in the language are disyllabic: monosyllabic and polysyllabic roots are said to be very rare, and are generally borrowed. One notable shortcoming of Yunus's description is that phonological phenomena of segmental alternations, in particular morphophonemic alternations are disregarded. This is expected within the taxonomic approach, as morphophonemics is not treated as part of the phonology component.

Farid's (1980) description is couched in the framework of generative phonology, as indicated by the title. His study attempts to describe certain phonological and morphological alternations found in the language, so as to make that description as revealing of the processes of Malay phonology and morphology as possible. As a rule-based approach, the regularities are captured and formalised into rules by using the formalism of the standard linear analysis.

Under Farid's analysis, the glottal stop is not regarded as part of the underlying phonemes due to the fact that its occurrence is highly predictable. Farid's phonemic inventory, therefore, is slightly more economical than Yunus's: 18 consonants and 6 vowels. With respect to syllable structure, both of them agree that Malay is a (C)V(C) language.

When a multilinear framework became prevalent in phonological theory, Farid's (1980) work was re-examined by Teoh ([1988]1994). The earlier linear representations of standard generative phonology are expanded in various multilinear ways. For instance, vowels and consonants are represented in the hierarchical model of Sagey (1986), and underlying segments are organised hierarchically into syllable structures built by an ordered series of basic syllabification rules in the style of Steriade (1982) and Levin (1984). Similarly to Yunus (1980), Teoh (1994:12&52) affirms that Malay has 19 consonants and 6 vowels in its phonemic inventory.

Contrary to Yunus (1980) and Farid (1980), Teoh (1994) claims that the basic syllable structure of Malay is CV(C), the requirement for onset is obligatory in this language. Given the insights afforded by multilinear phonology, Teoh (1994) noted that the Malay phonological phenomena can be accounted for in an observationally and explanatory adequate manner if the CV(C) assumption is adopted. Both Farid (1980) and Teoh's (1994) accounts will be reviewed in further detail in the appropriate chapters, particularly when the issues become relevant to the exposition.

As noted, Farid's (1980) pioneering work, which used Wilbur's (1973a) Global Theory, remains to date the only comprehensive study on the phonology of Malay reduplication. Following the assumption of the standard theory, he approaches reduplication as a morphological rule whose application precedes that of the phonological rules. After reduplication has applied, phonological rules scan both the input base and the output reduplicant to check for satisfaction of their structural descriptions. If the condition is met, either in the base or in the reduplicant, both the elements undergo the same phonological alternation. This behaviour is generally referred to as overapplication.



As I have commented earlier, there are two other attested reduplicative patterns namely underapplication and normal application which are disregarded in Farid's work, arguably because they cannot be accounted for under the global theoretic approach. Farid's (1980) analysis will be reviewed in more detail when we discuss reduplication in Chapter 5.

Subsequently, in their joint work on Correspondence Theory, McCarthy and Prince (1995b), reexamine one of Farid's overapplicational patterns, which involves a phonological rule of so-called Vowel Nasalisation. They view this overapplicational effect as interactional overapplication, where the base both triggers and undergoes the same phonological alternation. McCarthy and Prince (1995b) point out that this kind of interaction between phonology and reduplication is only possible in a theory with parallel evaluation of fully output structures, such as Correspondence Theory, which is set within Optimality Theory.

Since their analysis on the phonology of Malay reduplication is not extensive, they missed the important observation that Vowel Nasalisation occurs in the reduplicative pattern of normal application as well. It is apparent that these two patterns cannot be accounted for by the hierarchical ranking proposed in McCarthy and Prince (1995b). To overcome this drawback, I propose a different type of constraint ranking. The discussion of this matter will be presented in Chapter 5.

## 1.5 Data and methodology

As mentioned in §1.2, Johore Malay is generally considered the standard dialect of Malay. Consequently, previous phonological studies, in particular Yunus (1980), Farid (1980) and Teoh (1994), are based on Johore Malay, and Farid (1980) explicitly states that he is a native speaker of this dialect.

Following this tradition, my description is also based on Johore Malay. Specifically, the sources of this study are as follows:

- (i) Johore Malay data used in the previous literature, in particular Yunus (1980), Farid (1980) and Teoh (1994)
- (ii) My own observations
- (iii) and my own intuitions as a speaker of general Malay

The relevant data were transcribed phonetically. Words were next segmented into their constituent parts, namely, roots, prefixes and suffixes, in order to identify the various alternants of a single morpheme. The various alternants of a morpheme were examined to look for a pattern to the alternation. Such patterns of alternation are analysed in the main body of the thesis using the theoretical framework of Optimality Theory.

## 1.6 Purpose and scope of this study

The primary aim of the present study is to examine and to account for the regularities in Malay reduplication and incorporate them in the general properties of phonology, as well as in the general properties of the interface between the phonology and the morphology of the language. As noted, this aspect of reduplication has been underdescribed and understudied. This study focuses on one particular type of reduplication, generally called root reduplication — a process of copying the base root, and most often in conjunction with prefixation and suffixation.

Root reduplication is the most productive and versatile type of reduplication in the morphology of the language. Besides being associated with a variety of semantic nuances, the various combinations of reduplication and affixation give rise to a number of significant reduplicative patterns. This latter aspect of reduplication will be scrutinised extensively in this study, and not so much their semantic interpretations. It is apparent that some of these regular patterns are overlooked in Farid's (1980) ground-breaking study. One of the main aims is to describe all the reduplicative patterns observed in the language, which will subsequently lead to a revealing description of the phonology of Malay reduplication.

This study is couched in the theoretical framework of Correspondence Theory (McCarthy & Prince 1994, 1995b), set within the constraint-based approach of Optimality Theory, where the relations between Input-Output Faithfulness and Base-Reduplicant Identity are treated equally and formalised into a broadly identical set of formal constraints. Constraints of the two types are distinct, and therefore they are separately ranked in the hierarchy.

I shall demonstrate that the present analysis can account for all the reduplicative patterns in the language quite systematically and naturally, the emergence of each type being a consequence of the output candidate best satisfying the language's constraint hierarchy. The constraint-based account is superior to the rule-based analysis, in the sense that it fulfils the requirement of observational, descriptive and explanatory adequacies (Chomsky 1968).

This study also examines certain aspects of Malay phonology and the interface between phonology and morphology in suffixation and prefixation, as they become relevant to the present discussion. The particular aspect of phonology that comes under scrutiny is the segmental phonology, which includes phonological alternations and distributional restrictions.

With respect to this, the present study will reinterpret and reformalise the regular phonological phenomena which were previously formalised in terms of input-driven rewrite rules, into output well-formedness constraints. It will become evident that the present analysis must be preferred, as it manages to capture the generalisations more adequately. Furthermore, it can account for phenomena which are problematic under the previous rule-based analysis. One important aspect that has not been satisfactorily accounted for in previous analyses involves the irregularities which occur in the domain of suffixation and roots. This irregular behaviour is treated as an exception, and in certain cases the facts have been overlooked or misinterpreted.

Similarly to the case of reduplication, the effect of phonological irregularity is straightforwardly accounted for as the outcome of best satisfying the language's constraint hierarchy. In other words, the regular visibly active constraints have to be violated in order to ensure the satisfaction of a more dominant constraint in the hierarchy.

## 1.7 Theoretical background

This section presents an overview of the fundamental ideas and the essential architecture of Optimality Theory (henceforth OT) (Prince & Smolensky 1993; McCarthy & Prince 1993a), the theoretical approach adopted in this study. The pivotal analytical proposal of OT is that a grammar is a hierarchical ranking of well-formedness constraints. These constraints are specified in the Universal Grammar, and individual grammars are constructed by imposing a language-particular ranking on those universal well-formedness constraints.

The distinguishing feature of OT with respect to other constraint-based approaches is that it allows violation of the those universal constraints. Lower ranked constraints can be minimally violated in order to assure the satisfaction of higher ranked constraints. Universal

Grammar, according to McCarthy and Prince (1994:334) must include at least the following components:

- (1) **Con:** The set of constraints out of which grammars are constructed.  
**Gen:** A function defining, for each possible input  $i$ , the range of candidate linguistic analyses available to  $i$ .  
**Eval:** A function that comparatively evaluates sets of forms with respect to a given constraint hierarchy  $\Gamma$ , a ranking of **Con**.

As mentioned, with the advent of OT, the formalisation and the explanatory burden of linguistic generalisation have substantially been shifted from input-driven rewrite rules to output well-formedness constraints. Accordingly, this shift demonstrates a drastic change in how the relation between the input and output phonological forms is interpreted.

In the rule-based approach, as established in the standard theory of generative phonology propounded by Chomsky and Halle (1968) and many later works that build on it, the representation starts with an underlying form and is mapped to a surface form in a step-by-step procedure through a series of rules in a derivation. Each rule has a specific structural description and structural change. The output of each rule contributes as the input to the next one (i.e. intermediate representation), and finally the result of the derivation is the surface form.

In the constraint-based approach of OT, the actual surface output of the underlying input is selected from among a large set of potential surface forms commonly referred to as candidates. The selection is based on the well-formedness constraint system evaluation.

Schematically, the representational structure of a grammar in OT can be summarised as in (2) (McCarthy & Prince 1993a, 1994). This grammar pairs input  $/in/$  with output  $[cand_k]$ .

- (2)  $GEN(in_i) = \{cand_1, cand_2 \dots\}$   
 $EVAL(\{cand_1, cand_2 \dots\}) \rightarrow cand_k$  (the output, given  $in_i$ )

The function **GEN** (short for generator) will provide each input (underlying representation) with a large set of possible candidate outputs (surface representation) which is in principle infinite. According to Prince and Smolensky (1993), **GEN** produces candidate surface forms based on very general conditions. For the purposes of this study, the candidates generated by **GEN** will consist of all possible syllable parsing and segmental copying of an underlying form.

The function **EVAL** (short for evaluation) will assess the well-formedness of each member of the whole candidate set. The candidate that best satisfies or least violates the constraint system is termed optimal or most harmonic, and constitutes the actual surface form attested in the language.

In summary, there are five basic tenets of OT (McCarthy & Prince 1994:335).

- (3) (i) **Universality** — UG provides a set *Con* of constraints that are universal and universally present in all grammars.  
(ii) **Violability** — Constraints are violable; but violation is minimal.  
(iii) **Ranking** — The constraints of *Con* are ranked on a language-particular basis; the notion of minimal violation is defined in terms of this ranking. A grammar is a ranking of the constraint set.  
(iv) **Inclusiveness** — The constraint hierarchy evaluates a set of candidate analyses that are admitted by very general considerations of structural well-formedness.



- (v) **Parallelism** — Best-satisfaction of the constraint hierarchy is computed over the whole hierarchy and the whole candidate set. There is no serial derivation.

In what follows I shall illustrate schematically the notion of constraint interaction in the constraint hierarchy. To begin with, let us assume that there is a language *L* with two universal constraints *A* and *B*. The grammar of *L* is constructed depending on how *A* and *B* are ranked with respect to each other.

Like any grammar, the grammar of *L* will pair underlying forms with surface forms: GEN produces a set of possible candidate outputs, and EVAL selects the optimal one that is the candidate that best satisfies the constraint ranking. Suppose that for an underlying form /input/, there are two possible candidate surface forms namely [cand<sub>1</sub>] and [cand<sub>2</sub>], and that [cand<sub>1</sub>] is the actual surface form. If [cand<sub>1</sub>] and [cand<sub>2</sub>] are compatible, that is, one satisfies both *A* and *B*, while the other violates them, then there is nothing significant, and the notion of constraint ranking becomes irrelevant.

The ranking of constraints is crucial when there is a disagreement between [cand<sub>1</sub>] and [cand<sub>2</sub>], in particular when they are in a conflict situation with respect to the satisfaction and violation of *A* and *B*. For instance, [cand<sub>1</sub>] satisfies *A* and violates *B*, whereas [cand<sub>2</sub>] satisfies *B* and violates *A*. The two constraints oppose each other, where the satisfaction of one constraint leads to the violation of the other. This conflict is resolved by ranking the constraints in a strict dominance hierarchy (cf. Prince & Smolensky 1993a). Since [cand<sub>1</sub>] is, by assumption, the actual surface form, this suggests that the grammar of *L* requires that constraint *A* dominates constraint *B* (i.e. *A* >> *B*). In other words, *A* is ranked higher than *B* in the constraint hierarchy for *L*. In OT, the constraint ranking is represented in the form of a constraint tableau, which is a useful calculational device, as illustrated below.

- (4) Constraint tableau, *A* >> *B*, /input/ → [cand<sub>1</sub>]

Candidates	<i>A</i>	<i>B</i>
a. ☞ [cand <sub>1</sub> ]		*
b. [cand <sub>2</sub> ]	*!	

The tableau in (4) introduces some useful conventions, as follows: (i) constraints are represented in their domination order from left to right, that is the highest-ranked constraint is arranged in the leftmost column; (ii) possible candidates are listed in vertical order; (iii) constraint violation is marked by '\*', and constraint satisfaction is unmarked; (iv) constraint violations accompanied by an exclamation mark '!' suggest a fatal violation which is responsible for the elimination of a candidate; and (v) the optimal candidate output is signalled by a pointing finger '☞'.

The suboptimal candidate in (4) [cand<sub>2</sub>] is ruled out as it fatally violates *A*. The optimal candidate [cand<sub>1</sub>] avoids this violation at the expense of violating the lower-ranked *B*. This violation is, however, not significant since the victor has already been determined. As suggested in Optimality Theory, once a victor emerges, the remaining lower ranked constraints become irrelevant: whether the sole surviving candidate obeys them or not does not affect its grammaticality.

There are other ways where candidate outputs can interact, in particular when there is a tie with respect to the satisfaction or violation of a given constraint. Candidates are in a tie position when both of them pass or fail the higher ranked constraint equally. In this situation, the decision is made by consulting the next available constraint in the hierarchy.

- (5) Constraint tableau,
- $A \gg B$
- ,
- $/input/ \rightarrow [cand_1]$

Candidates	A	B
a. $\hookrightarrow [cand_1]$		
b. $[cand_2]$		*!

- (6) Constraint tableau,
- $A \gg B$
- ,
- $/input_k/ \rightarrow [cand_1]$

Candidates	A	B
a. $\hookrightarrow [cand_1]$	*	
b. $[cand_2]$	*	*!

As can be seen in (5), candidates  $[cand_1]$  and  $[cand_2]$  both satisfy the higher ranked constraint A equally, and this constraint cannot contribute to a decision between them. Due to this tie relation, the next constraint in the hierarchy, that is B, must be referred to. At this stage,  $[cand_1]$  fatally violates B, while  $[cand_2]$  satisfies B. Hence, the latter is pronounced as the winner.

In (6), a tie relation occurs when both candidates violate the high ranked constraint A equally. Similarly, A cannot determine the optimal form, therefore the evaluation has to consult B.  $[cand_1]$  passes B, while  $[cand_2]$  fails B, and hence the former is more harmonic than the latter. This interaction reveals that constraint violation is not essentially the end of a candidate's chances. A violation of a constraint can be fatal only when there are other competitive candidates that satisfy it.

Another type of interaction that must be considered concerns multiple violations of a single constraint in the grammar. In this case the violation is assessed gradually, rather than categorically. Suppose another underlying form  $/input/$  from L produces the following candidate outputs:

- (7) Multiple Violation,
- $A \gg B$
- ,
- $/input/ \rightarrow [cand_1]$

Candidates	A	B
a. $\hookrightarrow [cand_1]$		*
b. $[cand_2]$		***!


Candidates  $[cand_1]$  and  $[cand_2]$  tie on A, and as expected, the evaluation goes to B to determine the optimal output. As shown,  $[cand_1]$  is more harmonic, because its accumulated violations of B are less as compared to the failed candidate  $[cand_2]$ . B is violated minimally here, and by the evaluation of minimal violation,  $[cand_1]$  emerges as the victor.

It must be mentioned that, as noted in McCarthy and Prince (1993a:88), constraint violations are not counted, but are merely a comparison more versus less, that is a matter of ordering and not of quantity (cf. Prince & Smolensky 1993). In this case,  $[cand_1]$  and  $[cand_2]$  are compared for violations with respect to B. At the first stage, both are violating B equally, so they are in a tie position. They are subject to B again, and on this second pass,  $[cand_1]$  spares A, but  $[cand_2]$  does not. Constraint B now rules out  $[cand_2]$  in favour of  $[cand_1]$ .

It is important to note that not all constraints are crucially ranked. Constraint ranking becomes relevant only in the case of potential conflict, that is, a satisfaction of one constraint leads to a violation of another in a nonoptimal candidate. When constraints do not conflict,

they are not ranked with respect to each other. This type of interaction is represented by a dotted vertical line in the tableau.

(8) A, B >> C, /input<sub>m</sub>/ → [cand<sub>1</sub>]

Candidates	A	B	C
a.  [cand <sub>1</sub> ]			*
b. [cand <sub>2</sub> ]		*!	
c. [cand <sub>3</sub> ]	*!		

Violations of A and B are regarded as equal because interchanging these constraints makes no difference to the outcome. Both candidates [cand<sub>2</sub>] and [cand<sub>3</sub>] are not the optimal output, and thus their interaction is not significant. As noted in McCarthy and Prince (1993a), the potential conflict between constraints over the ill-formed candidates is, as a matter of principle, of no interest. In the case of C, it has to be ranked with respect to A and B because the decision is called upon C.

## 1.8 Structure of this book

The present study is organised into six chapters. The organisation of the remaining chapters is as follows. Chapter 2 discusses the general properties of the Malay syllable and examines how syllable structure plays a significant role in governing and conditioning most of the phonological phenomena in the language.

Chapters 3 and 4 investigate the phonology and morphology interface in suffixation and prefixation, respectively. It is apparent that the morphophonological behaviour of suffixation in this language is quite distinct both in character and degree of generality from prefixation. Processes that are visibly active at the stem-suffix juncture are inapplicable at the prefix-stem boundary, and vice versa.

The phonological asymmetry between prefixation and suffixation is accounted for in the present study as a consequence of a candidate output to best satisfy the constraint hierarchy, particularly with respect to prosody-morphology interface constraints which govern the interactions at the morpheme boundaries.

After presenting the background phonology of the language, Chapter 5 investigates how the phonology interacts with the morphology in the process of reduplication. The particular type of reduplication that comes under scrutiny is Root Reduplication — a process of copying the base root, most often in conjunction with prefixation and suffixation. The various combinations of reduplication and affixation give rise to a number of interesting phonological properties which will be examined and accounted for.

The analysis of Malay reduplication is couched in the theoretical framework of Correspondence Theory (McCarthy & Prince 1994, 1995b), set within the constraint-based approach of OT. Earlier in this chapter, I present a brief introduction to the fundamentals of Correspondence Theory. The Correspondence Theory of reduplication comes in two models, namely, the Full Model and the Basic Model. In the present study I adopt the Basic Model approach.

After a brief overview of reduplication in the language, I move to the core focus of this study, that is, to examine and account for the phonology of Malay reduplication.

Phonological regularities in reduplication are exemplified with three types of canonical patterns, commonly dubbed overapplication, underapplication and normal application.

Chapter 5 will demonstrate that the parallelist Correspondence Theory can account for all the three reduplicative patterns observed in Malay. Over-, under- and normal application are regulated under a single constraint hierarchy. All the possible candidate outputs are evaluated symmetrically and simultaneously with respect to this ranking. This suggests that neither the base nor the reduplicant has serial priority in the interaction. As theoretically expected, the optimal form is always the candidate that best satisfies the ranking hierarchy.

Finally, in Chapter 6 I briefly summarise the general findings of this study. These concern phonology, the interface between phonology and morphology, and aspects of reduplicative phonology. In the concluding remarks, I note that there are interesting phonological regularities in Partial Reduplication and Nasal Coalescence not explored here, and left for future research.

## 2 *Syllable structure and syllabification*

---

### 2.1 Introduction

In this chapter I shall examine the aspects of Malay phonology which are governed and conditioned by syllable structure and syllabification. As generally accepted, syllable structures are not present in the lexical representation, and are derived in the course of phonological derivation. Section 2.2 briefly outlines how the process of syllabification is construed in the framework of OT.

It is a well established fact that the sonority hierarchy plays a major role in determining the nucleus and margins of the syllable. Vowels are more sonorous than consonants, and basically make more harmonic nuclei and less harmonic margins. Within the vowels, the high vocoids are less sonorous, and therefore they can potentially qualify as margins. In the literature, high vowels in the margins are referred to as ‘glides’, and claimed to be members of the underlying inventory of contrasting phonological segments in the language (Abdullah 1974; Yunus 1980; Farid 1980; Teoh 1994). In §2.3 I shall argue that there are no such segments as ‘glides’ in Malay, as there are no phonological grounds for establishing them.

Malay generally requires that every surface syllable must have an onset. Underlying hiatus is resolved by C-epenthesis. Although this requirement is generally observed, it can be violated in certain environments. This fact is well observed and attested in Yunus (1980), but is not satisfactorily accounted for in the analyses of Farid (1980) and Teoh (1994). Section 2.4 demonstrates that this generalisation can be captured satisfactorily under the OT account.

Despite the fact that the Malay syllable may have a single member coda, there is a restriction in the language which prohibits a small class segments from occupying the coda position. This is reflected in various forms of alternations. The prohibition of some segments in the coda is governed by the Syllable Coda Condition (Itô 1986), and this will be explored in §2.5.

It has been previously proposed that Johore Malay has a rule, the so-called Vowel Lowering, which changes high vowels to mid-vowels in the environment of a closed final syllable. In §2.6 I shall argue that there is no strong phonological evidence or motivation for postulating such a rule, and therefore it should be discarded in the Malay grammar. In my analysis, mid-vowels are present underlyingly in that environment.

## 2.2 Basic syllable structure and syllabification

It has long been claimed that the basic structure of the Malay syllable is (C)V(C) (Abdullah 1974; Yunus 1980; Farid 1980). Typologically, this language belongs to a class of languages which Clements and Keyser (1983) refer to as a type IV group that has four basic syllable structures, namely V, VC, CV and CVC. This claim, however, has been rejected by Teoh (1994) who claims that Malay is a type III language with a CV(C) syllable structure, and that every syllable must have an onset.

In contrast with Teoh (1994), I am more inclined towards the earlier proposal that Malay syllable is (C)V(C). The language generally requires that every surface syllable must have an onset. Despite the fact that this requirement is generally observed, it can be violated in certain environments, in particular word initially and root internally.

I postulate that Malay has 16 underlying consonants — /p, b, t, d, k, g, tʃ, dʒ, s, h, m, n, ɲ, ŋ, l, r/ and 6 underlying vowels — /i, u, e, o, ə, a/. This inventory is more economical than the ones proposed before (i.e. Farid (1980) — 18 consonants 6 vowels; Abdullah (1974), Yunus (1980) and (Teoh 1994) — 19 consonants 6 vowels).

As mentioned above, the sonority hierarchy plays a major role in determining the nucleus and margins of the syllable. Vowels are more sonorous than consonants, and basically make more harmonic nuclei and less harmonic margins. In Malay only vowels are permitted in the syllable nucleus position, whereas consonants are variably associated with the syllable margins, namely onset and coda. Each syllabic constituents (e.g. onset, nucleus, coda) can only be occupied by a single segment, suggesting that the language disfavours segmental clusters.

As commonly accepted by most phonological theories, syllable structures are not present in the lexicon, and are derived in the course of phonological derivation. Within the OT framework, the process of syllabification is a matter of choosing the optimal output from among the possible analyses, rather than algorithmic structure building (Prince & Smolensky 1993:15). Syllable structure is generated in the same way as any other grammatical property by the function GEN, which produces a set of candidates with various possibilities of syllable parsing from each unsyllabified input. These possible candidates are then evaluated in parallel by the function EVAL based on a language particular constraint hierarchy. As expected, a candidate that minimally violates the constraints in the hierarchy is termed optimal and pronounced as the true output.

In early OT (Prince & Smolensky 1993; McCarthy & Prince 1993a), syllabification is construed as a process of incorporating segments into higher prosodic constituents. Phonological elements are said to be 'parsed' when they are associated and dominated by the appropriate node of the prosodic hierarchy, and this is controlled by a formal constraint called PARSE. As a family of constraints, PARSE provides a number of constraints that ensure parsing, such as PARSE-SEGMENT which requires that all segments must belong to moras and PARSE-μ which demands that all moras be parsed into syllables. A constraint family is a group of similar and related constraints which are all built from a single broad concept (i.e. PARSE) but they are separately rankable in the hierarchy.

With the advent of Correspondence Theory (McCarthy & Prince 1995b), the earlier faithfulness constraints of the PARSE family have been subsumed under the MAX constraint

<sup>1</sup> This consonant sound inventory has often been regarded as the primary consonants or native consonant sounds. In addition, there are also secondary or loan consonants, namely fricative sounds /f, v, θ, ð, z, ʃ, x/ which may occur in borrowed words mainly from Arabic and English. These loan consonants are retained only in the speech of educated group, but for most speakers in general they are simply being replaced by the closest native equivalent sounds (see Farid 1980:19 and Yunus 1980:88).



family which requires that every segment of  $S_1$  (input/base) has a correspondent in  $S_2$  (output/reduplicant). PARSE-SEGMENT is now reformulated as MAX-IO, which demands that every segment of the input must have a correspondent in the output.<sup>2</sup> A process of phonological deletion is reckoned as a violation of MAX-IO.<sup>3</sup> Similarly, PARSE- $\mu$  can be reformulated as MAX-IO- $\mu$ .

The process of syllabification is primarily an interaction of the faithfulness constraint MAX-IO and the syllable structure constraints, such as ONSET, NO CODA and \*COMPLEX, which are formally defined as follows:

(9) Syllable structure constraints (Prince & Smolensky 1993)

ONSET — Syllables must have onsets

NO CODA — Syllables must not have a coda

\*COMPLEX — No more than one segment may associate to any one syllabic constituent (i.e onset, nucleus, coda)

Let us first consider the interaction between MAX-IO and the syllable structure constraint NO CODA. It is apparent that MAX-IO and NO CODA can be in a relation of conflict which means that there are pairs of competing candidates on which the two constraints are in disagreement. One of the candidates (the actual output form) must emerge as optimal.

As noted, MAX-IO demands that all the input segments must appear on the surface regardless of whether the form has an illicit syllable structure, for instance a syllable with a coda. This is to ensure that all underlying segments are parsed. On the other hand, NO CODA disallows any coda element. Since Malay is a (C)V(C) language which optionally allows codas, the relevant ranking is: MAX-IO dominates NO CODA. This conclusion is illustrated in the following tableau (syllable boundaries are marked by a full stop '.').

(10) MAX-IO >> NO CODA — /pasti/ 'sure, certain'


/pasti/	MAX-IO	NO CODA
a. pa.ti	*!	
b.  pas.ti		*

Tableau (10) shows that faithfulness to the underlying form by parsing all the input segments leads to a violation of a syllable structure constraint. Generally, such a violation can be avoided by vowel epenthesis, which is one way of ensuring that all the input segments are parsed, and concurrently satisfying the NO CODA syllable structure constraint.


In standard OT analysis, epenthesis is governed by another faithfulness constraint called FILL (Prince & Smolensky 1993; McCarthy & Prince 1994), which states that all nodes of syllable structure must be filled by underlying segments. In the Correspondence Theoretic approach, this constraint is subsumed under the DEP constraint family which demands that every segment of  $S_2$  (output/reduplicant) has a correspondent in  $S_1$  (input/base). FILL is now reformulated as DEP-IO, which requires that every segment of the output must have a correspondent in the input.

<sup>2</sup> The correspondence relation that involves a base and reduplicant will be discussed in Chapter 5.

<sup>3</sup> The crucial difference between violating PARSE-SEGMENT and MAX-IO is that in the former case the unrealised surface segment is not deleted, but remains unparsed (marked by an angle bracket < >). This is due to the principle of Containment which forbids any deletion of input materials. In the latter case, however, this is interpreted as phonological deletion.


DEP-IO can also be in a conflict relation with NO CODA. The latter requires a syllable without any coda, and this can be achieved by inserting an epenthetic schwa interconsonantly. The former, by contrast, favours a nonepenthetic form, even if it has an illicit syllable structure. In Malay, DEP-IO clearly outranks NO CODA. The interaction is shown in the tableau below.

(11) DEP-IO >> NO CODA

/pasti/	DEP-IO	NO CODA
a. pa.sə.ti	*!	
b.  pas.ti		*

Another possible form that should be considered is [pa.sti]. In this candidate, the intervocalic consonant cluster /s/ and /t/ are both parsed to the second syllable, creating a complex structure in the onset node. Considering the available constraints developed in (10) and (11), this candidate obeys all their requirements, and thus it would be the most harmonic. However, this is not the correct surface form. It must then be the case that another constraint is crucially involved in ruling out this candidate, and this constraint must be more dominant. The relevant constraint that plays a crucial role here is \*COMPLEX which bans the occurrence of clusters in any node of the syllable structure. This constraint is unviolated, therefore undominated in the hierarchy.

(12) \*COMPLEX >> NO CODA

/pasti/	*COMPLEX	NO CODA
a. pa.sti	*!	
b.  pas.ti		*

Malay loan phonology offers a good piece of evidence that \*COMPLEX is highly respected in the language. Borrowed lexical items containing clusters are generally resolved by schwa epenthesis and C-deletion. For example, English words like *stamp*, *glass*, *class*, *club*, *post* are realised as [sətem], [gəlas], [kəlas], [kəlap] and [pos], respectively.<sup>4</sup>


It must be mentioned that in principle, MAX-IO, DEP-IO and \*COMPLEX are also in a conflict situation with respect to each other. For instance, \*COMPLEX disallows complex onset such as [pa.sti], and this can be resolved either by C-deletion (i.e. [pa.ti]) or by V-epenthesis (i.e. [pa.sə.ti]). The satisfaction of \*COMPLEX by the former compels a violation of MAX-IO, whereas the latter involves the DEP-IO violation. MAX-IO demands that all the input segments must appear on the surface regardless of whether the syllable contains an illicit consonant cluster (i.e. [pa.sti]). Likewise, DEP-IO requires a nonepenthetic form even though that form has an illicit consonant cluster.

The potential conflict between the three constraints, however, is not significant because all the three candidates are ill-formed. In this case the constraints at hand are not crucially ranked with respect to each other. Conventionally, this kind of interaction is indicated by a dotted line in the tableau.

<sup>4</sup> It must be noted that in literary Malay, particularly under the new spelling system 1975 (Pedoman Umum Bahasa Malaysia) consonant clusters in borrowed words are preserved in the orthography. However, in the old spelling system (Ejaan Sekolah), such clusters are not permitted.



## (13) \*COMPLEX, MAX-IO, DEP-IO &gt;&gt; NO CODA


/pasti/	*COMPLEX	MAX-IO	DEP-IO	NO CODA
a. pa.sti	*!			
b. pa.ti		*!		
c. pa.sə.ti			*!	
d.  pas.ti				*

After evaluating NO CODA, let us assess the position of ONSET as it interacts with the faithfulness constraints MAX-IO and DEP-IO. Malay generally requires that every surface syllable must have an onset. Underlying vowel sequences derived by morphemic concatenation can never be faithfully syllabified. For instance, a morphological process of prefixation that brings together /V+V/, cannot be syllabified heterosyllabically as [V.V], since it produces an onsetless syllable, a clear violation of ONSET. The hiatus is then resolved by C-Epenthesis. The examples in (14) show that the vowel clusters surface as a heterosyllabic sequence separated by a glottal stop.

- |      |                  |                |                         |
|------|------------------|----------------|-------------------------|
| (14) | /di + ubah/      | [diʔubah]      | 'to move (passive)'     |
|      | /di + ikat/      | [diʔikat]      | 'to tie (passive)'      |
|      | /dʒuru + atʃara/ | [dʒuruʔatʃarə] | 'master of ceremony'    |
|      | /sə + indah/     | [səʔindah]     | 'to be as beautiful as' |
|      | /sə + elok/      | [səʔeloʔ]      | 'to be as pretty as'    |
|      | /kə + ibu + an/  | [kəʔibuwan]    | 'motherhood'            |
|      | /kə + əmas + an/ | [kəʔəməssan]   | 'golden'                |

The occurrence of epenthetic glottal stops intervocalically in the above examples is triggered by the ONSET requirement. Obedience to ONSET compels a violation of DEP-IO, as the output glottal stop has no correspondent in the input form. The two constraints conflict with each other, and evidently DEP-IO must be dominated by ONSET.

## (15) ONSET &gt;&gt; DEP-IO

/di + ubah/	ONSET	DEP-IO
a. di.u.bah	*!	
b.  di.ʔu.bah		*

Potentially, there are two other possibilities for ensuring ONSET satisfaction. The first candidate is \*[du.bah], where one of the vocalic segments in the input undergoes the process of deletion. This leads to a violation of the faithfulness constraint MAX-IO, which ensures that all the input materials must surface in the output. Deleting a vowel to ensure ONSET satisfaction is never permitted in this language. However, it must be pointed out that a consonant can be deleted when it conflicts with the structural well-formedness constraint (see §2.5.3). Similarly, inserting a consonant is permissible (see 15b) but not a vowel (see 13c). The generalisation that can be deduced from this is that the deletion/insertion of a vowel and the deletion/insertion of a consonant have a very different status in Malay.

It is common cross-linguistically that vowels behave quite differently from consonants. In OT, this distinction is captured by positing two different and related constraints of MAX-IO and DEP-IO, namely MAX-IO<sub>VOW</sub>/MAX-IO<sub>CONS</sub> and DEP-IO<sub>VOW</sub>/DEP-IO<sub>CONS</sub>. These constraints

resemble  $\text{PARSE}^{\text{CONSONANT}}/\text{PARSE}^{\text{VOWEL}}$  and  $\text{FILL}^{\text{CONSONANT}}$  and  $\text{FILL}^{\text{VOWEL}}$  in early standard OT (Prince & Smolensky 1993). Constraints of these two types are distinct, and therefore they are separately rankable in the hierarchy. Given the facts of Malay, it is evident that the vowel faithfulness constraints, namely  $\text{MAX-IO}_{\text{VOW}}/\text{DEP-IO}_{\text{VOW}}$  are highly ranked than the consonant faithfulness constraints  $\text{MAX-IO}_{\text{CONS}}/\text{DEP-IO}_{\text{CONS}}$ .

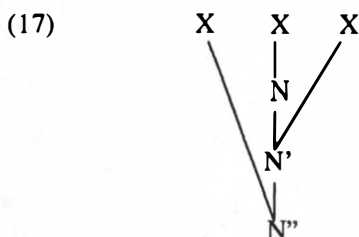
The second candidate is \*[dju.bah], where the high vowel is parsed in the onset. Although this candidate spares  $\text{ONSET}$ ,  $\text{MAX-IO}_{\text{VOW}}$  and  $\text{DEP-IO}_{\text{CONS}}$ , it fatally violates the undominated syllable structure constraint \*COMPLEX. The interaction between the four constraints is controlled by the following ranking: \*COMPLEX,  $\text{MAX-IO}_{\text{VOW}} \gg \text{ONSET} \gg \text{DEP-IO}_{\text{CONS}}$ . The first two constraints do not conflict, and therefore they are not crucially ranked with respect to each other.<sup>5</sup>

- (16) \*COMPLEX,  $\text{MAX-IO}_{\text{VOW}} \gg \text{ONSET} \gg \text{DEP-IO}_{\text{CONS}}$

/di + ubah/	*COMPLEX	MAX-IO <sub>VOW</sub>	ONSET	DEP-IO <sub>CONS</sub>
a. di.u.bah			*!	
b. du.bah		*!		
c. dju.bah	*!			
d. $\text{di} \cdot \text{u.bah}$				*

In conclusion, the process of syllabification in OT involves choosing the most harmonic output between a set of candidates with various possibilities of syllable parsing based on the interaction of wellformedness constraints ranked on a language particular basis. Considering all the constraints we have discussed so far, we can establish the hierarchical ranking as follows: \*COMPLEX,  $\text{MAX-IO}_{\text{VOW}} \gg \text{ONSET} \gg \text{DEP-IO}_{\text{CONS}} \gg \text{NO CODA}$ .

In the rule-based analysis of Teoh (1994), Malay syllable structures are constructed in a step-by-step fashion. He adopts Levin's (1984) syllable structure and syllabification procedure, which has a strong resemblance to the X-bar syntactic structure, as represented in (17).



The syllable is construed as a projection of the syllabic nuclei which is represented as an N node. This nucleus node is immediately dominated by two other nodes, namely N' (the rhyme) and N'' (the syllable 'σ'). The coda can be defined as the 'complement' (right sister) of the nucleus, dominated by the first projection of N', and the onset as the 'specifier' (left sister) of the syllable, dominated by the second projection of N''. In the case where N' and N'' projections are absent, the nucleus vowel functions as a complete constituent just like a syntactic head without any complement or specifier.

<sup>5</sup> The phenomenon of Glottal Epenthesis at the prefix boundary will be discussed in more detail in Chapter 4, §4.2.1.

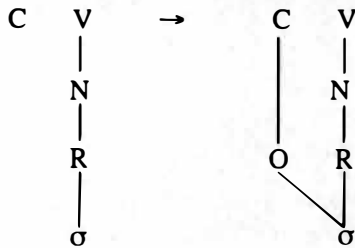
Technically, the procedural nature of syllabification in Teoh (1994) encounters some analytical problems. One noted criticism is that the incorporation of a post-nucleus melodic segment into syllable structure prior to the pre-nucleus segment contradicts the universally observed precedence of onset formation formally captured by many proposals such as the CV rule (Steriade 1982), the Maximal Onset Principle (Selkirk 1982), the Onset First Principle (Clements & Keyser 1983), the Onset Creation Rule (Hyman 1985), the Universal Core Syllable Condition (Itô 1986), and the Minimal Onset Satisfaction Principle (Roca 1994).

By incorporating Levin's (1984) view of syllable structure and Steriade's (1982) CV rule, Teoh (1994:27) posits that Malay basic syllable structures are produced by an ordered series of three syllable building rules, namely (i) a nucleus building rule, (ii) an onset building rule, and (iii) a coda building rule, which can be formalised as in (18).<sup>6</sup>

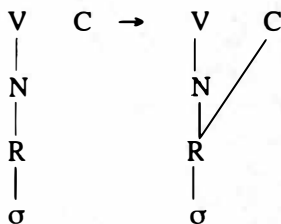
- (18) (i) Nucleus building rule — assign a vocalic segment to the nucleus.



- (ii) Onset building rule — assign a preceding consonant to the onset.



- (iii) Coda building rule — assigns a single free consonant to the coda of the preceding syllable.

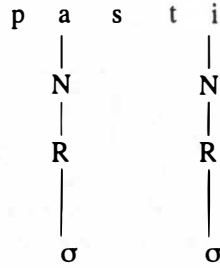


How this set of rules operates is illustrated in the following derivation.

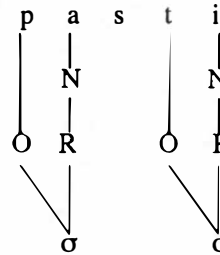
<sup>6</sup> It must be noted that the formalisation in (18) is much more complex than the one proposed by Teoh (1994:27). I enrich the representation for convenience of exposition.

(19) /pasti/ 'sure, certain'

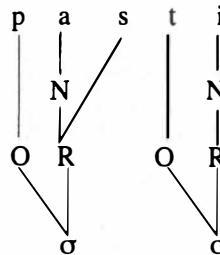
(i) Syllabification Rule 1



(ii) Syllabification Rule 2



(iii) Syllabification Rule 3



Apparently, the procedural syllabification algorithm in (19) works satisfactorily if the underlying forms consist of a successive sequence of consonant and vowel segments, such as CVCV, CVCVC or CVCCVC, etc. In cases where the underlying forms contain sequences of vowels, particularly in combination with high vowels (e.g. /hairan/ 'surprised', /leuat/ 'late', /uanji/ 'fragrance'), an additional syllabification rule would then be required to reassign the nucleic high vocoid in the V-slot to a syllable margin in the C-slot (see §2.3.4 below). From the point of view of Prosodic Phonology, this additional rule is not phonologically motivated because the melodic segment, in this case the high vowel, has already been licensed. Therefore, it is not independently required by the syllabification algorithm.

### 2.3 ONSET satisfaction: vowel sequences and the syllabification of high vowels

As observed in relation to the data in (14) that underlying vowel sequences derived by morphemic concatenation cannot be syllabified heterosyllabically because it creates an onsetless syllable, an obvious violation of ONSET. The hiatus is then resolved by Glottal Epenthesis, and the price for this overparsing is a DEP-IO<sub>CONS</sub> violation. The schematic ranking that has been established is ONSET >> DEP-IO<sub>CONS</sub>.

Heterosyllabic parsing of vowel sequences within a morpheme is also disfavoured in the language. Underlying clusters with prevocalic, postvocalic and intervocalic high vowels cannot be syllabified heterosyllabically. For instance, underlying /HV, /VH/ or /VHV/ (i.e. V stands for vowel and H for high vowel) cannot be parsed as [H.V], [V.H] or [V.H.V]. Unlike in the heteromorphemic case, the optimal way of resolving vowel sequences morpheme internally is not by Glottal Epenthesis, but by parsing the high vowels in the margin.

As mentioned, it is a well-known fact that the sonority hierarchy plays a major role in determining the nucleus and margins of the syllable. Vowels are more sonorous than consonants, and therefore they make more harmonic nuclei and less harmonic margins. Within the vowels, the high vocoids are less sonorous than the non-high ones. Thus, in accordance with the Sonority Sequencing Generalisation<sup>7</sup> (or Sonority Sequencing Principle) (Selkirk 1984:116), the high vowels can qualify as margins in the pre-, post- and intervocalic environments.

In the literature, high vowels occurring in the margins are commonly referred to as 'glides', and are classified as [-syllabic, -consonantal] segments in SPE (Chomsky & Halle 1968). There are however strong objections against the use of the SPE feature [ $\pm$  syllabic] for representing syllabicity. Syllabicity alternations have been examined in numerous languages, and for the most part appear to be predictable and non-distinctive (Blevins 1995:221). Syllabicity has been established to be a consequence of both segmental substance and relational adjacency. Thus, most phonological theories accept that syllable structures are not present in the lexicon, and are generated in the course of phonological derivation. In compliance with this assumption, a specification [ $\pm$  syllabic] becomes meaningless and therefore should be discarded. An obvious consequence of the ban on [ $\pm$  syllabic] is that there is no such thing as 'glides', if by 'glide' is meant a [-syllabic] high vowel (Roca 1997).

In the spirit of Roca (1997), Durand (1987), Clements and Hume (1995), I claim that there are no such underlying segments as 'glides' in Malay, as there are no phonological grounds for establishing them. This contradicts the previous view about 'glides', which are regarded as members of the underlying inventory of contrasting phonological segments in the language (Abdullah 1974; Yunus 1980; Farid 1980; Teoh 1994).<sup>8</sup> I suggest that there is no difference in phonological substance between 'glides' and high vowels, the distinction between the two arising exclusively from their respective syllabification.

In this section I primarily examine syllabification of high vowels within morphemes. Cross-boundary syllabification, namely across suffix and prefix boundaries, will be explored later, in Chapters 3 and 4 respectively. To begin with, I lay out some of relevant examples illustrating surface syllabification of high vowels in three different positions, namely prevocalic, intervocalic and postvocalic, as listed in (22) below. For convenience, the occurrence of high vowels /i, u/ in margin positions is conventionally transcribed as [j, w].

<sup>7</sup> The Sonority Sequencing Generalisation states that 'In any syllable, there is a segment constituting a sonority peak that is preceded and/or followed by a sequence of segments with progressively decreasing sonority values' (Selkirk 1984:116).

<sup>8</sup> Although Teoh (1994:29) does put forward an assumption that the high vowels and glides do not differ in their feature structure and the distinction between them can be determined by the syllable structure, all these segments are still represented as underlying phonemes in his analysis.

(20) Surface syllabification of high vowels morpheme-internally<sup>9</sup>

## a. Prevocalic position — HV(C).

[wa.ŋĩ.]	'fragrance'
[ja.ken.]	'to convince'
[ju.ran.]	'fee'
[waŋ.]	'money'
[kah.wen.]	'to marry'
[daʔ.wat.]	'ink'
[kas.wi.]	'a kind of cake'

## b. Intervocalic position — CV.HV(C).

- (i)
- |           |                   |
|-----------|-------------------|
| [le.wat.] | 'late'            |
| [la.wan.] | 'enemy'           |
| [wa.jaŋ.] | 'movie'           |
| [la.ju.]  | 'to wither'       |
| [ku.ju.]  | 'half closed eye' |
| [se.wə.]  | 'rent'            |
- (ii)
- |               |                   |
|---------------|-------------------|
| [bu.wah.]     | 'fruit'           |
| [ku.weh.]     | 'cake'            |
| [si.jap.]     | 'complete'        |
| [ku.wi.nĩ.]   | 'a kind of mango' |
| [pi.ju.taŋ.]  | 'loan'            |
| [bi.ja.sə.]   | 'usual'           |
| [mẽŋ.ku.waŋ.] | 'screw-pine'      |

## c. Postvocalic position — CVH.

[pi.saw.]	'knife'
[gu.raw.]	'to joke'
[pa.kaj.]	'to wear'
[pan.daj.]	'clever'
[sə.poj.]	'blowing softly'
[do.doj.]	'lullaby'
[taw.lan.]	'friend, comrade'
[haj.ran.]	'surprised, wonderment'

The descriptive generalisations that are observed in (20) can be summarised as follows: (i) in morphemes with sequences of three vowels, the intervocalic high vowel is always parsed in the onset (20b) and (ii) in morphemes with sequences of two vowels, the high vowel is parsed tautosyllabically either in the coda (20c) or in the onset (20a), depending on whether it occurs in postvocalic or prevocalic position. We shall examine each of these syllable parsings in turn. For convenience, we begin with the postvocalic distribution (20c), followed by the intervocalic (20b) and the prevocalic environments (20a).

<sup>9</sup> Vowels immediately preceded by nasal consonants are always nasalised in Malay. Nasality spreads progressively until it is blocked by an oral consonant. For the purposes of present discussion, Vowel Nasalisation will be overlooked, and its detail will be pursued in §4.6.

### 2.3.1 Postvocalic high vowel

As shown in (20c), a postvocalic high vowel is parsed tautosyllabically in the coda, giving rise to a falling diphthong. It has long been claimed that Malay has three diphthongs, namely /ai/, /au/ and /oi/ (Za'ba 1964; Abdullah 1974; Asmah 1975; Yunus 1980; Farid 1980; Nik Safiah 1989).

We have seen earlier that underlying vowel sequences derived by morphemic concatenation cannot be parsed heterosyllabically, since it yields an onsetless syllable, an instance of violation of ONSET. To eschew the ONSET violation, the hiatus is then resolved by Glottal Epenthesis. The price for Glottal Epenthesis is a violation of DEP-IO<sub>CONS</sub>. We then established the schematic ranking MAX-IO<sub>VOW</sub> >> ONSET >> DEP-IO<sub>CONS</sub> (16).

Although Glottal Epenthesis is visibly active in the language, it is not permitted within the root domain. In this particular case, the most harmonic way of avoiding the ONSET violation is by parsing the postvocalic high vowel tautosyllabically with the preceding vowel, and a falling diphthong surfaces. This option survives MAX-IO<sub>VOW</sub>, ONSET and DEP-IO<sub>CONS</sub>, at the expense of violating the syllable structure constraint \*M/V in (21).

- (21) \*M/V (Prince & Smolensky 1993)

Vowels may not associate to Margin nodes (Onset and Coda).

It is apparent that not any vowel in Malay can be parsed in the syllable margin, but only the high vowels. This behaviour is quite common cross-linguistically. Under the OT framework, this generalisation is captured by a set of micro constraints of the \*M/V family which are determined by the sonority hierarchy such as \*M/i,u , \*M/e,o , \*M/a and \*M/ə (cf. Prince & Smolensky 1993; Kenstowicz 1994c). These constraints are distinct, therefore separately rankable in the hierarchy.

I assume that the sonority hierarchy in Malay does not distinguish between mid and low vowels (cf. Selkirk 1984). Hence, the only distinction is that the high vowels are less sonorous than the non-high ones. Thus, the relevant constraints at play here are \*M/H and \*M/NH, as formally defined below.

- (22) a. \*M/H

High vowels may not associate to Margin nodes (Onset and Coda).

- b. \*M/NH

Non-high vowels may not associate to Margin nodes (Onset and Coda).


Unlike \*M/H, the syllable structure constraint \*M/NH is unviolated, therefore undominated in the constraint hierarchy (see also §2.4).<sup>10</sup> In order for tautosyllabification to be optimal, \*M/H must be ranked below DEP-IO<sub>CONS</sub> in the hierarchy.

Another possible alternative that must be considered is that of parsing both vowels in the nucleus, creating clusters in that syllabic constituent. This vacuously satisfies \*M/H, since the vowel does not occur in the margin node. This satisfaction of \*M/H, however, compels a serious violation of the syllable structure constraint, \*COMPLEX, which disallows the association of more than one segment to any one syllabic constituent (i.e. onset, nucleus, coda). Similarly to MAX-IO<sub>VOW</sub>, \*COMPLEX is an unviolated constraint, therefore cannot be dominated in the ranking hierarchy. Putting all the constraints together, the relevant ranking

<sup>10</sup> The satisfaction of \*M/NH compels a violation of ONSET within the root internal domain. This is an instance where ONSET is violated in the language. See §2.4 for details.

that can be established here is as follows: MAX-IO<sub>vow</sub>, \*COMPLEX >> ONSET >> DEP-IO<sub>CONS</sub> >> \*M/H.

(23) Tautosyllabic parsing in the rhyme.


/hairan/	*COMPLEX, MAX-IO <sub>vow</sub>	ONSET	DEP- IO <sub>CONS</sub>	*M/H
a. ha.i.ran		*!		
b.  haj.ran				*
c. ha.ran	MAX-IO <sub>vow</sub> *!			
d. ha.j.ran	*COMPLEX *!			*
e. ha.ʔi.ran			*!	

As can be seen, the tautosyllabified candidate (23b) spares ONSET at the expense of violating the syllable structure constraint \*M/H. The parsing of the high vowel in the margin incurs a violation of NO CODA as well. This violation, however, is insignificant, because NO CODA is lower ranked in this language, as we have seen in tableau (13).

### 2.3.2 Intervocalic high vowel

In morphemes with sequences of three vowels, the intervocalic high vowel is always associated to the onset node. Similarly to the postvocalic case mentioned above, this is a strategy to eschew the ONSET violation. Under the same hierarchical ranking as established in (23), the grammar predicts that a candidate with a marginal parsing of the high vowel emerges as the most harmonic output, as illustrated in the following tableau.

(24) Parsing of intervocalic high vowel in the onset.

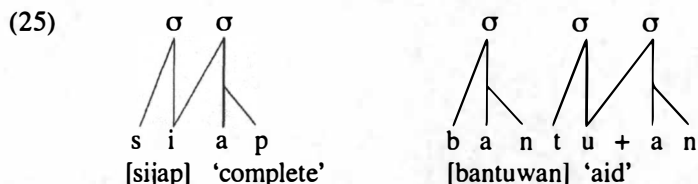
/leuat/	*COMPLEX, MAX-IO <sub>vow</sub>	ONSET	DEP- IO <sub>CONS</sub>	*M/H
a. le.u.at.		**!		
b.  le.wat.				*
c. lat.	MAX-IO <sub>vow</sub> **!			
d. leu.at.	*COMPLEX *!	*		
e. lwat.	MAX-IO <sub>vow</sub> *! *COMPLEX *!			*
f. le.ʔu.ʔat.			**!	

As far as the underling form is concerned, it is apparent that morphemes such as in (20bii) must consist of sequences of two vowels instead of three, since a sequence of two identical vowels is ruled out by the Obligatory Contour Principle (OCP). Thus, the underlying representation of a form such as [kuwini] is /kuini/, not /kuiini/. In previous analyses the occurrence of surface 'glides' in (20bii) is treated as an epenthetic segment, derived by the so-called Glide Insertion rule (cf. Abdullah 1974; Farid 1980; Zaharani 1993; Teoh 1994).

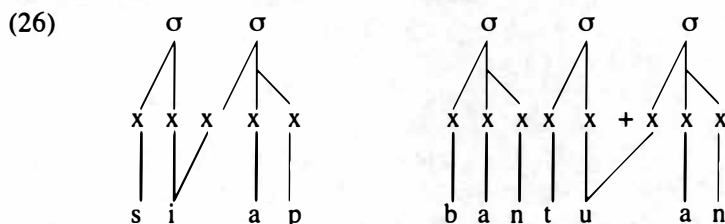
Within the framework of OT, the occurrence of margin high vowels (i.e. 'glides') in the hiatal environment in (20bii) is interpreted as a consequence of syllable parsing. In McCarthy and Prince's (1993b) analysis of Malay/Indonesian, this phenomenon is explained



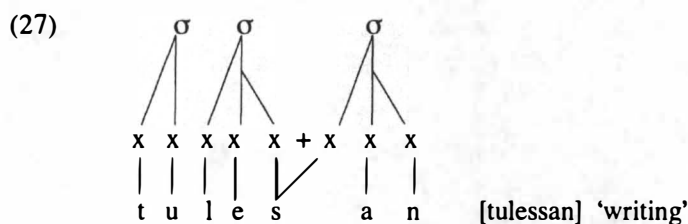
as the result of parsing the high vowel ambisyllabically that is as the nucleus of one syllable and as the onset of the following one. It is crucial to note that the epenthetic segments [j, w] are not derived by default, but from the input high vowels. Therefore, the faithfulness constraint FILL (DEP-IO<sub>CONS</sub> in our analysis) is not violated here (Rosenthal 1994).<sup>11</sup> Ambisyllabification is represented, as in (25).



Contrary to McCarthy and Prince (1993b), I shall construe the structure in (25) as an ambiskeletal<sup>12</sup> parsing, that is, the high vowel is parsed to two X-skeletal (timing units) (Levin 1985), which are then immediately dominated by two successive syllables. The first X-slot is associated to the nucleus, while the second X is associated to the following onset. Ambiskeletal parsing is now illustrated in (26).



The representations in (26) are very close to those for a geminate consonant in (27) (see §3.2 for detailed discussion). The significant difference between (24) and (27) is that in the former the first of the Xs is associated to a nucleus, while in the latter it is parsed to a coda. In short, ambiskeletal parsing gives rise to two types of geminate, namely V-geminate<sup>13</sup> (26) and C-geminate (27).



It has long been observed that a geminate commonly involves as a single melodic element behaving as equivalent to sequences of two segments for various processes. Segment length in a geminate is generally represented in a skeletal framework as mapping of a single set of features to two skeletal positions. By contrast, in a moraic framework it is represented as features mapped to a mora.

<sup>11</sup> It must be noted that the outputs in (25) are not completely faithful. They only spare a DEP-IO<sup>SEGMENT</sup> violation but violate DEP-IO<sup>X</sup>, since there is a new X-slot in the output representation.

<sup>12</sup> I am grateful to Iggy Roca for suggesting this term to me.

<sup>13</sup> There are cases where the high vowel is associated to the coda and onset simultaneously, creating a true V-geminate (e.g. /pakai+an/ 'cloth' → [pakajjan]). See §3.2.1 for detailed discussion.

In a Correspondence Theoretic approach, an ambiskeletal parsing in a geminate is interpreted as a one-to two mapping from the input to the output; two output segments stand in correspondence with a single input segment. The relation between the input and the output in ambiskeletal structure is illustrated below.



As can be seen in (28), both the output segments  $X_1$  (i.e. [i] or [u]) and  $X_2$  (i.e. [j] or [w]) have an input correspondence, that is, the root node /Root<sub>1</sub>/ (i.e. /i/ or /u/). By definition, therefore, the output segment  $X_2$  is not epenthetic, and thus it satisfies DEP-IO<sub>CONS</sub>, which demands that every segment of the output have a correspondent in the input. This interpretation is compatible with the notion of ambisyllabic parsing proposed in standard Optimality Theory (McCarthy & Prince 1993; Rosenthal 1994; Lamontagne & Rice 1995).

However, it must be noted that there is a crucial difference between a geminate and ambisyllabicity. The doubly-linked structure in a geminate, which denotes a long segment, generally tends to resist separation by rules of epenthesis, and fails to undergo phonological rules whose structural descriptions are satisfied by only one part of the geminate structure — properties referred to as integrity and inalterability respectively (cf. Kenstowicz & Pyle 1973; Hayes 1986). For instance, a rule of schwa-insertion in the Ait Segrouchen dialect of Berber fails to apply to a geminate that has been created by a rule of assimilation (Guerssel 1978). Also in Tigrinya, a Semitic language, a geminate *k* derived by assimilation fails to undergo a rule of spirantisation (changing it to *x*), a rule that applies to both *k* and *q* when they are preceded by a vowel (Steriade 1982).

The doubly-linked structure in ambisyllabicity, on the other hand, involves a short single segment, which commonly triggers certain phonological alternations. For example, English *t* is flapped in practically all American dialects in words like *city*, *sitting*, or *sitter*, but not in *sister*, and *settee*. According to Kahn (1976), the condition for flapping is, the ambisyllabicity of the *t* in *city*, etc. In German, an underlying fricative /ç/ surfaces as [x] in words such as *rauchen* 'smoke', or *knochig* 'boney', but not in *Frauchen* 'mistress (of an animal), little woman' or *Masochist* 'masochist'. Merchant (1994) accounts for this alternation as the result of ambisyllabicity of the /ç/ in *rauchen*, or *knochig*.

Observe that the representation in (28) involves multiple correspondences. Under Correspondence Theory, a formal constraint that is violated here is INTEGRITY which is defined in McCarthy and Prince (1995b) as follows:<sup>14</sup>

(29) INTEGRITY

No element of the input has multiple correspondents in the output.

In principle, an ambiskeletal parsing does not involve multiple segment correspondents. What actually happens here is that there is a single input segment associated to two X-timing units. In accord with this interpretation, a more appropriate constraint that is applicable here is INTEGRITY-X, which is part of the INTEGRITY constraint family.

<sup>14</sup> Lamontagne and Rice (1995) propose a correspondence constraint called \*MULTIPLE CORRESPONDENCE (\*MC) to account for a similar phenomenon.


## (30) INTEGRITY-X

No element of the input has multiple X correspondents in the output.

The correspondence constraint (30) militates against structure with multiple associations. This rules out ambiskeletal parsing in V-geminate (26) and C-geminate (27).

The preference of ambiskeletal parsing over Glottal Epenthesis suggests that INTEGRITY-X must be ranked lower than DEP-IO<sub>CONS</sub>, so that the latter can be ruled out in the competition. Note that an ambiskeletal parsing also violates \*M/H, since it involves an association of high vowels to the syllable margin. Under such conditions, INTEGRITY-X and \*M/H do not need to be crucially ranked: no matter how they are ordered, a candidate violating INTEGRITY-X can never emerge as the winner. Putting all the relevant constraints in (23) together with (30), I establish the following partial constraint ranking: COMPLEX, MAX-IO<sub>vow</sub> >> ONSET >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X, \*M/H.

## (31) Ambiskeletal parsing of high vowel.

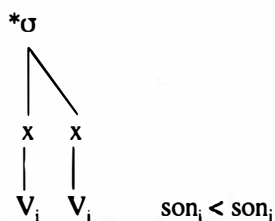
/kuini/	*COMPLEX, MAX-IO <sub>vow</sub>	ONSET	DEP-IO <sub>CONS</sub>	INTEGRITY-X	*M/H
a. ku.i.ni		*!			
b.  ku.wi.ni				*	*
c. kwi.ni	*COMPLEX *!				*
d. ku.ni	MAX-IO <sub>vow</sub> *!				
e. ku.ʔi.ni			*!		

Observe that there is a significant difference between an intervocalic segment [w] in candidate (31b) and a glottal stop in candidate (31e). The latter is an epenthetic element without any input correspondent, and therefore it fatally incurs a violation of DEP-IO<sub>CONS</sub>, which militates against C-epenthesis. The failed candidate (31c) syllabifies the first high vowel tautosyllabically in the onset, creating clusters [kw] in the onset node, a fatal violation of \*COMPLEX. Candidate (31b) emerges as the victor as it minimally violates only the lower ranked constraints INTEGRITY-X and \*M/H.

Considering the available constraints in (31), another potential candidate \*[kuj.ni] can be generated by parsing the high vowel /i/ tautosyllabically with the first syllable. This candidate seems to be more harmonic than (31b), as it passes INTEGRITY-X and minimally violates the lowest constraint \*M/H. Since \*[kuj.ni] is not the actual output, it must be ruled out by some other constraints. Surely, this particular constraint must be ranked higher than INTEGRITY-X in the hierarchy.

It is apparent that not any vowel sequence in Malay can be syllabified tautosyllabically, but only sequences of non-high vowels and a high vowel in either order. To exclude tautosyllabic sequences of high + high vowels or non-high + non-high vowels, a sonority constraint called SONFALL (Sonority Fall) is imposed requiring that a diphthong must have a decrease in sonority (cf. Rosenthal 1994). In other words, the sonority of the first vowel must be greater than the sonority of the second vowel.


## (32) SONFALL



According to the Sonority Sequencing Generalisation (Selkirk 1984), the sonority profile of the syllable must slope down from the peak to the syllable margin. The constraint SONFALL is in conformity with this general requirement. I assume that the sonority hierarchy in Malay does not distinguish between mid and low vowels (cf. Selkirk 1984). Hence, the only distinction is that high vowels are less sonorous than non-high vowels. Following this assumption, SONFALL rules out tautosyllabic sequences like [uj], [iw], [aɛ] and [aɔ].

Considering all the relevant constraints mentioned thus far, we establish the following part of the constraint hierarchy: MAX-IO<sub>vow</sub>, \*COMPLEX, SONFALL >> ONSET >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X, \*M/H.

## (33) Ambiskeletal parsing of high vowel.


/kuini/	*COMPLEX, MAX-IO <sub>vow</sub> , SONFALL	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. ku.i.ni		*!			
b.  ku.wi.ni				*	*
c. kwi.ni	*COMPLEX *!				*
d. kuj.ni	SONFALL *!				*
e. ku.ni	MAX-IO <sub>vow</sub> *!				
f. ku.ʔi.ni			*!		

## 2.3.3 Prevocalic high vowel

As in the two previous cases, the phonological motivation that triggers the parsing of prevocalic high vowels in the onset is to avoid a hiatus (20a). This type of parsing occurs in two environments, namely, in root medial and root initial positions.


Most of the previous works regard the occurrence of [j] and [w] in these environments as part of the lexical representations (Yunus 1980; Farid 1980; Abdullah 1974). For instance, forms such as /uaŋi/, /iuran/ and /kahuen/ are represented as /waŋi/, /juran/ and /kahwen/. This representation suggests that Malay essentially has so-called 'glides' in its phonemic inventory. As mentioned in §2.3, this analysis misses an important generalisation about the fact that the occurrence of 'glides' in this language is predictable and non-distinctive.

In our analysis, the emergence of [j, w] in this environment is a consequence of parsing the high vowel in the onset tautosyllabically with the following vowel. It seems indisputable that the structural motivation for this syllabification is to avoid a hiatus. Although there are many plausible candidates, they fare no better against the tautosyllabic candidate. In the table below, I list down some of the possible candidates for /kahuen/ 'to marry' and the constraints they potentially violate.

- (34)
- | Candidates   | Constraints Violated   |
|--|------------------------|
| a. *[ka.huen]  | *COMPLEX, SONFALL      |
| b. *[ka.hwen]  | *COMPLEX, *M/H         |
| c. *[ka.hen]   | MAX-IO <sub>VOW</sub>  |
| d. *[ka.hu.en]   | ONSET                  |
| e. *[ka.hu.ʔen]  | DEP-IO <sub>CONS</sub> |
| f. *[ka.hu.wen]  | INTEGRITY-X, *M/H      |
| g.  [kah.wen] | *M/H                   |

As established before, \*COMPLEX and MAX-IO<sub>VOW</sub> are undominated constraints, and therefore can never be violated. This rules out candidates (34a), (34b) and (34c). Violating the higher ranked ONSET and DEP-IO<sub>CONS</sub> are also fatal, and these eliminate (34d) and (34e). The competition is now between candidates (34f) and (34g). The former satisfies ONSET at the expense of violating INTEGRITY-X, whereas the latter does not incur such violation. The violation of \*M/H by both candidates is irrelevant as it does not conflict with INTEGRITY-X. The following tableau sums up the argument we just made.


- (35) Parsing of prevocalic high vowel in the onset.

/kahuen/	*COMPLEX, MAX-IO <sub>VOW</sub> , SONFALL	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. ka.hu.ɛn	*COMPLEX *! SONFALL *!				
b. ka.hwen	COMPLEX *!				*
c. ka.hen	MAX-IO <sub>VOW</sub> *!				
d. ka.hu.en		*!			
e. ka.hu.ʔen			*!		
f. ka.hu.wen				*!	*
g.  kah.wen					*

In avoiding the INTEGRITY-X violation, the optimal candidate incurs more violations of NO CODA. However, this is not significant, because NO CODA is lower ranked in the constraint hierarchy. Although Malay tolerates syllable codas, there is a restriction by which some segments are not permitted in the coda position. This prohibition is governed by the syllable structure constraint CODA COND which is highly ranked in the language.<sup>15</sup> Obedience to CODA COND can be achieved by parsing the high vowel ambiskeletalically, as the following tableau shows.

<sup>15</sup> See §2.5 for detailed discussion on CODA COND in Malay.


## (36) Ambiskeletal parsing of high vowel — i.e. /bəruaŋ/ ‘bear’

/bəruaŋ/	*COMPLEX, MAX-IO <sub>vow</sub> , SONFALL	ONSET, CODA COND	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. bə.ru.aŋ	*COMPLEX *! SONFALL *!				
b. bə.rwaŋ	*COMPLEX *!				*
c. bə.raŋ	MAX-IO <sub>vow</sub> *!				
d. bə.ru.aŋ		ONSET *!			
e. bə.ru.ʔaŋ			*!		
f.  bə.ru.waŋ				*	*
g. bə.r.waŋ		CODA COND*!			*

Tautosyllabic parsing in the onset also occurs root initially (e.g. /uaŋi/ → [waŋi] and /iuran/ → [juran]). An ambiskeletal parsing is blocked, and forms such as \*[uwaŋi] and \*[ijuran] are not the true outputs. It is observable that an ambiskeletal parsing is inadequate in this environment because it only provides an onset for the second vowel, while the initial vocoid still remains onsetless. On the other hand, if the initial high vowel is parsed directly to the onset, the candidate satisfies ONSET at the price of violating the low ranked constraint \*M/H.

Given the same constraint hierarchy established earlier, the optimal candidate inevitably falls to the one that undergoes tautosyllabification, as the following tableau demonstrates.

## (37) Parsing of prevocalic high vowel in the onset

/iuran/	*COMPLEX, MAX-IO <sub>vow</sub> , SONFALL	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. i.u.ran		**!			*
b. i.ran	MAX-IO <sub>vow</sub> *!	*			
c. i.ju.ran		*!		*	*
d. iw.ran	SONFALL *!	*			
e. ʔi.ju.ran			*!	*	*
f.  ju.ran					*

## 2.3.4 Previous accounts

As far as the phonology of Malay ‘glides’ is concerned, some substantial works that are relevant to the present discussion are Farid (1980), Durand (1987) and Teoh (1994). Farid’s description is couched in the framework of linear generative phonology of SPE (Chomsky & Halle 1968). He proposes two types of ‘glides’ in Malay, namely lexical ‘glides’ and non-lexical ‘glides’. The former occurs in two specific environments — prevocalic position and

intervocalic position. Thus, forms in (20a) and (20bi) are lexically represented in Farid (1980) as /waji/, /juran/, /kahwen/, /lewat/, /laju/, /wajan/, etc.

The non-lexical 'glides' are generated in the course of phonological derivation via two general rules called Marginal Vowel Derived Rule (38) and Glide Insertion (39). They are underlyingly high vowels in postvocalic and prevocalic positions, such as in /pisau/, /gurau/ (20c), /kuini/, /piutan/ (20bii), etc. In Farid's (1980) analysis, following SPE's feature representation (Chomsky & Halle 1968), the distinction the high vowels and the lexical 'glides' is categorised by the features [syllabic] and [consonantal] — high vowels are classified as [+syllabic, -consonantal], and lexical 'glides' as [-syllabic, -consonantal].

As previously mentioned, there are strong objections against the use of the SPE feature [ $\pm$ syllabic] for representing syllabicity. Most phonological theories affirm that syllabicity is predictable and non-distinctive, and therefore it must not be represented in the lexicon, as it can be generated in the course of phonological derivation.

Farid's (1980) rules, the so-called Marginal Vowel Derived Rule and Glide Insertion, which capture the occurrences of non-lexical 'glides' in (20c) and (20bii), are formalised in terms of SPE formalism, as in (38) and (39) below.

(38) Marginal Vowel Derived Rule (Farid 1980:22)

$$V \rightarrow \underset{\text{[- high]}}{\underset{\cdot}{V}} / V \text{ \_\_\_\_\_\_}$$

(39) Glide Insertion (Farid 1980:51).

$$\emptyset \rightarrow \left[ \begin{array}{c} \text{- syllabic} \\ \text{- consonantal} \\ \text{+ high} \\ \alpha \text{ low} \\ \beta \text{ back} \end{array} \right] / \left[ \begin{array}{c} V \\ \text{+ high} \\ \alpha \text{ low} \\ \beta \text{ back} \end{array} \right] \text{ \_\_\_\_\_\_ } V$$

Rule (38) states that, "the first of a sequence of two vowels, if it is non-high, will be realised as syllable nucleus, and the second vowel will be realised as syllable margin" (Farid 1980:22). This rule accounts for the surface occurrence of diphthongal 'glides' in (20c). Remarkably, this rule is also applicable to mid vowels, such as underlying /naik/ 'to ascend' becomes [naɛʔ]. As Farid (1980:22) pointed it out, 'In the case of /naik/, for example, the vowel /a/ is realised as [a] at syllable nucleus, and the following vowel /i/ is realised as [e], as a result of Vowel Lowering, at syllable margin'.<sup>16</sup> One general comment about this representation is that, it creates a complex coda, which runs against the basic syllable structure (C)V(C) proposed in Farid's (1980:24) analysis.

Rule (39), which inserts a homorganic 'glide' between a high vowel and another vowel, accounts for the distribution of 'glides' in (20bii). As currently argued, SPE formalism, such as in (39) is very unconstrained and cumbersome. More generally, other substantial criticisms that apply to SPE apply to Farid (1980) as well, and therefore we are not going to review his analysis in further detail.

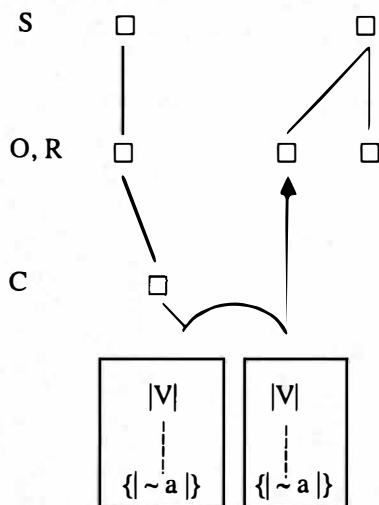
<sup>16</sup> I shall argue in §2.6 that there is no strong phonological evidence for postulating the so-called Vowel Lowering, and therefore it should be discarded in the Malay grammar. I will also argue in §2.4 that the mid vowel in [naek] is parsed in the nucleus, not in the margin (cf. Yunus 1980; Teoh 1993).



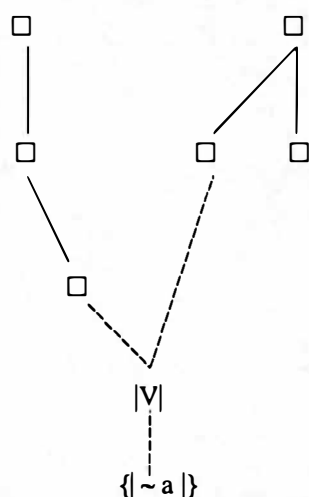
Unlike Farid (1980), Durand (1987) argues that the phonology of Malay does not require a category of 'glides' ('semi-vowels' in his terminology), and they are simply high vowels in non-syllabic positions. His analysis is conducted under the Dependency Phonology framework. To account for the phenomenon of Glide Insertion in (20bii), Durand (1987:94) offers two possible non-linear analyses: (i) a process which copies a rhyme-final high vowel (specified as  $\{|\sim a|\}$ ) into the free onset of the next syllable, or (ii) a process of simple reassociation within the same configuration. The two solutions are formalised by Durand (1987:95) as in (40) below.

(40) Semi-Vocalisation (Durand 1987:95)

(a) High Vowel Copying



(b) High Vowel Reassociation



According to Durand (1987:95), the choice of (i) over (ii) is not significant, and therefore he adopts Semi-Vocalisation as a neutral term here. What is relevant is that the simplest analysis is to treat these 'glides' or 'semi-vowels' simply as the high vowel in a non-syllabic disguise.

However, as noted in Durand (1987:97), there is a problem with respect to the rule of Semi-Vocalisation formulated in (40), because it fails to predict the data in (20a) and (20bi). For instance, forms such as /uaji/, /iuran/, /laiu/, /kuiu/ become \*[uawaji], \*[ijuran], \*[laiju] and \*[kuwiju], respectively, rather than [waji], [juran], [laju] and [kuju]. In solving this problem, Durand (1987:97) points out that, 'Two solutions are open to us: either we mark certain |V|'s as inherently non-syllabic, or we modify our account of Semi-Vocalisation. I shall suggest further down that on the evidence of a wider range of data, the second option is the one we should follow'.

Durand (1987:99) then revised the rule of Semi-Vocalisation, which he claims to apply to any high |V| preceding a non-high |V|. Thus, forms like /buah/ and /tiap/ in (20bii) become [bwah] and [tjap] respectively, surfacing as monosyllabic words with complex onset. Durand (1987:98) argues that the syllable template for Malay has to be somewhat more complex than traditionally assumed: the Malay syllable template allows for complex onsets and codas (e.g. [bwah] 'fruit', [kweh] 'cake' [bjasə] 'usual'). He also commented that Farid's Glide Insertion rule is somewhat oversimplified. In particular, it is not the case that every /...CiV.../ or /...CuV.../ sequence surfaces as a disyllabic form with glide epenthesis or reassociation: [...CijV...] or [...CuwV...].



However, Durand (1980:98) notes that there seems to be some variation. For instance, forms such as *tuah* 'luck' and *hias* 'to decorate' are always realised as [tuwah] not \*[twah], and [hijas] not \*[hjas]. Since he disfavours the rule of Glide Insertion, he accounts for this generalisation by postulating that the underlying forms for *tuah* and *hias* as /tuuah/ and /hiias/ respectively. One notable comment about this representation is that it violates the high ranking constraint OCP which prohibits two adjacent identical vowels.

To account for diphthongisation in (20c), following Farid (1980), Durand (1987) captures this process as the result of Marginal Vowel Derived rule which makes a postvocalic high vowel non-syllabic when it follows a non-high vowel. In contrast with Farid, this rule does not apply to mid vowels, and therefore an underlying /naik/ 'to ascend' surfaces as [najk] and not [naɛʔ] as described in Farid (1980).<sup>17</sup>

In short, Durand's (1987) analysis offers two important generalisations. First, Malay does not require a category 'glides', in agreement with the present study. Second, Malay may have complex syllable structures which allows complex onsets and codas. This claim is obviously in contradiction with the present proposal, as well as with the traditional assumption that the basic structure of the Malay syllable is simplex (cf. Yunus 1980; Farid 1980; Teoh 1994).

Given the facts of Malay, forms with complex onsets, such as \*[bwah] and \*[tjap] are not grammatical, because they run against the canonical sound pattern of the language (cf. Yunus 1980; Farid 1980; Teoh 1994). If complex onsets were to be allowed, these would be the only clusters that ever occurred in the language. In addition, psychological evidence from a language game demonstrates that [bu.wah] and [ti.jap] are clearly disyllabic words with simplex structure.

In Malay, there is a language game which involves reversing syllables between a non-ludling word and a ludling 'nonsense' word. For instance, words like [pi.saw] 'knife' and [la.ju] 'to wither' are transformed into [saw.pi] and [ju.la]. In the case of [bu.wah] and [ti.jap], the reversal words are realised as [wah.bu] and [jap.ti] respectively. Since there is a disagreement between Durand's interpretation and ours with respect to the Malay data, we refrain from commenting any further about the merit of Durand's Dependency Theoretic approach.

Teoh's (1994) description, couched in a multi-linear framework, seems to be more relevant, and it will be reviewed in detail in this section. As far as 'glides' are concerned, Teoh's proposal with respect to their phonological status is not firmly consistent. At one point he seems to deny the existence of 'glides', as he asserts in Teoh (1994:29):

We assume that /i/ and /j/ as well as /u/ and /w/ do not differ in their feature structure. The distinction between high vowel and glide will be a function of syllable structure. A [+high, -cons] segment in onset will be interpreted as a glide while the same features in the syllable nucleus are realised as a high vowel.

However, in another place, particularly in his description about the consonant inventory of the language, he clearly postulates that /j/ and /w/ are part of the Malay phoneme inventory (Teoh 1994:52). In his distinctive feature matrix, the segments /j/ and /w/ are specified as [+high, -syllabic, +consonantal] (Teoh 1994:53). His inconsistency is observable in his representation of some of the Malay data. For instance, the underlying forms for [wanj] 'fragrance' and [jaken] 'confident' are represented as /wanj/ and /jakin/, whereas for [ju] 'shark' and [jan] 'which' are represented as /iu/ and /ian/ respectively. It is apparent to me

<sup>17</sup> As can be seen the two transcriptions are incompatible with respect to each other. We shall discuss this in more detail in the following §2.4.

that the reason /j/ and /w/ are treated as lexical 'glides' in /waji/ and /jakin/ is that this is the only way the phenomenon of Nasal Deletion can be formally captured.<sup>18</sup>

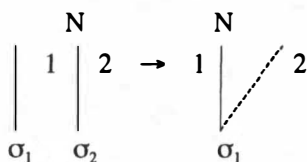
In Teoh's analysis, 'glides' are derived by four types of syllabification rules, namely (i) Diphthongisation, (ii) Devocalisation, (iii) Glide Insertion, and (iv) Glide Formation. Before we go to each of these rules, it is important to note Teoh's general proposal with respect to Malay basic syllable structure and syllabification procedures.

As mentioned, Teoh (1994:28) argues that Malay is a language with a CV(C) syllable structure, requiring an obligatory onset but with an optional coda. The phonotactic constraints of the language do not allow the onset or coda to have consonant clusters. By incorporating Levin's (1984) syllable structure and Steriade's (1982) CV rule, Teoh (1994:29) posits that the syllabification algorithm is produced by an ordered series of three syllable building rules, as in (18).

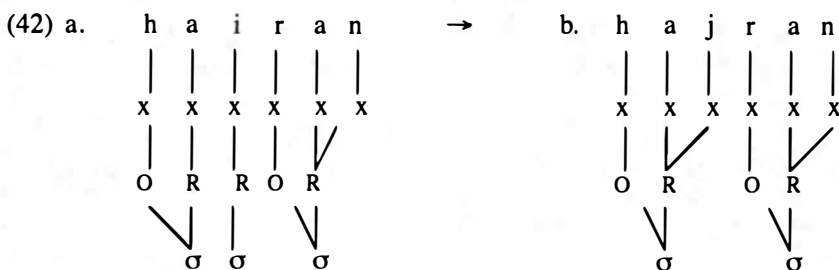
The rules in (18) are basic syllabification rules, whereas the rules for deriving 'glides', such as (i) Diphthongisation, (ii) Devocalisation, (iii) Glide Insertion, and (iv) Glide Formation, are additional syllabification rules which generally involve resyllabification.

To account for the occurrence of diphthongal 'glides', as in (20b), Teoh (1994:23) postulates a rule called Diphthongisation, an additional syllabification rule which converts the syllabic high vowel (i.e. N associated to  $\sigma_2$ ) into a non-syllabic glide. This rule is formalised in (41).

(41) Diphthongisation Rule (Teoh 1994:23)



Rule (41) simply means that the syllabic high vowel in the second syllable is reassociated tautosyllabically as a coda of the first syllable and realised as offglide. The effect of the Diphthongisation rule is shown in the derivation below.



The structural representation in (42a) is constructed by the basic procedural syllabification building rules in (18). The Diphthongisation rule is then brought into action by reassociating the syllabic /i/ tautosyllabically to the coda of the preceding syllable, to derive a representation such as in (42b). A substantial question that arises here is that of what the motivation for such a rule is. At first glance, it seems that this additional conversion rule is not phonologically motivated because the melodic segment, in this case the high vowel /i/, has

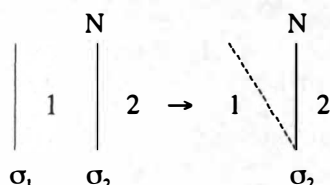
<sup>18</sup> This alternation will be discussed in §4.5 in Chapter 4.

already been licensed, and therefore it is not independently required by the syllabification algorithm.

However, by understanding the basic assumption proposed by Teoh (1994), that every Malay syllable must have an onset, it is clear that the motivation underlying the Diphthongisation rule is to avoid an onsetless syllable. The preferability of a diphthong to avoid an onsetless syllable is of course fully explicit only in OT, as illustrated in tableau (23).

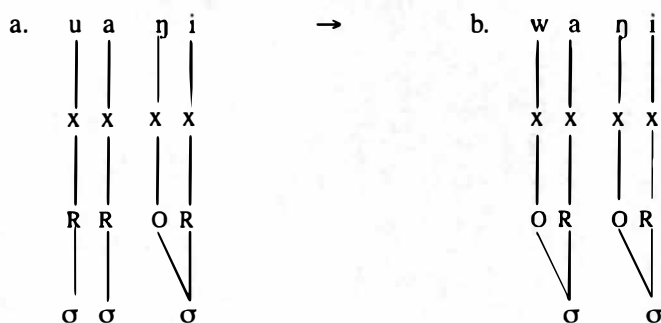
To account for the occurrences of intervocalic glides (20bi) and prevocalic glides root initially (20a), Teoh (1994) postulates a phonological rule called Devocalisation, which converts the syllabic high vowel into a non-syllabic glide through resyllabification. According to Teoh (1994:30), the environment of this rule is '... when it is followed by another vowel and it is preceded by a vowel or by the word boundary'. However, as can be seen in (43), the statement of the rule itself makes no such claim. It is quite obvious that vowel and word boundary do not form a natural class.

(43) Devocalisation rule (Teoh 1994:30)

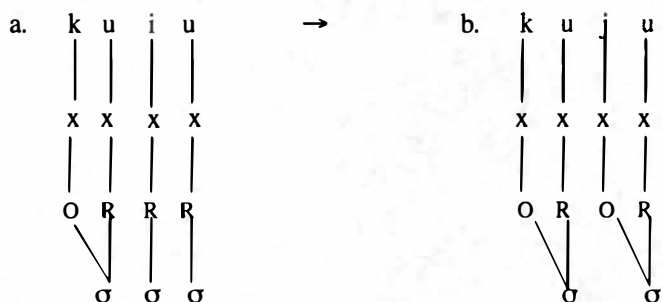


How Devocalisation operates in deriving surface forms such as [waŋi] 'fragrance' and [kuju] 'half closed eye' from underlying forms /uaŋi/ and /kuiu/ is illustrated in the derivations in (44) and (45) below.

(44) Devocalisation – root initial



(45) Devocalisation – root medial



The basic procedural syllabification building rules will first construct the structural representation in (44a) and (45a). The Devocalisation rule then reassociates the syllabic high vowel to the onset of the following syllable, to derive the representations in (44b) and (45b). Similarly to Diphthongisation, although the high vowel has already been fully syllabified, the additional conversion rule of Devocalisation is essentially required in order to assure that every syllable has an onset.

Teoh (1994:31) notes that the rule in (43) is a schema which will obviously overgenerate. Since its structural description is fully met, Desyllabification will apply to underlying forms such as /buah/ and /siap/, generating the incorrect surface forms \*[bwah] and \*[sjap], respectively. To circumvent this shortcoming, Teoh (1994:31) proposes a syllable structure constraint which allows only a single segment in the onset. This constraint rules out illicit forms such as \*[bwah] and \*[sjap].<sup>19</sup>

As proposed in Teoh's work, every syllable in Malay requires an onset. In compliance with this requirement, the vowel sequences in /buah/ and /siap/ obviously cannot surface heterosyllabically as \*[bu.ah] and \*[si.ap] respectively. In this case, according to Teoh (1994:31), '... a hiatus breaking glide is inserted providing every syllable with an onset. The onset is realised as a homorganic glide deriving its feature from the preceding vowel with [+high,  $\alpha$  round] features'. The process of Glide Insertion is illustrated in the following derivation.

(46) Glide Insertion

a. Underlying melodies with syllabification

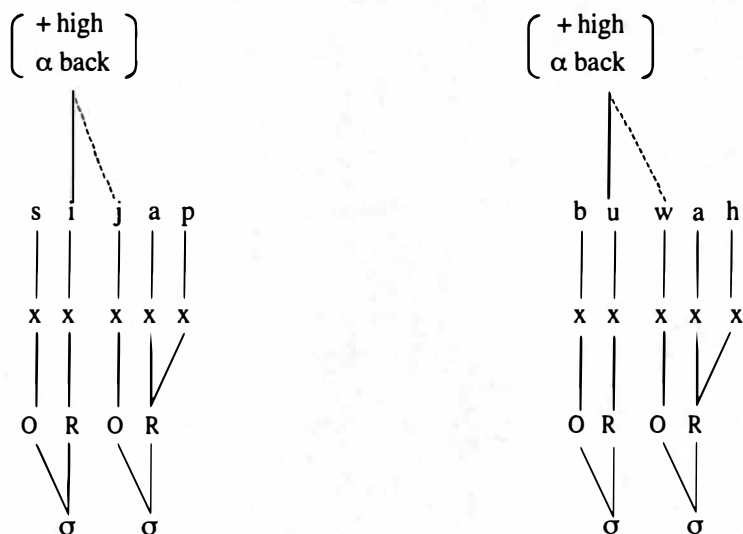


b. X-insertion



<sup>19</sup> These forms are regarded as the correct outputs in Durand (1987). As I commented above, these data run against the phonology of the language, which disallows segmental clusters in any one syllabic constituent (i.e. onset, nucleus, coda) (cf. Yunus 1980; Farid 1980; Teoh 1994).

## c. Feature spreading



It must be mentioned that in addition to Glide Insertion, Teoh (1994:74–75, 82–83) postulates another rule called Glide Formation, which specifically applies across a morpheme boundary, in particular at the stem-suffix juncture. Glide Formation is construed as a process spreading the features  $[+high, \alpha back]$  of the final high vowels of the stem to an available empty X-slot of vowel-initial suffixes.

Thus, with respect to the vowel-initial suffixes  $/-an/$  and  $/-i/$  in Malay, Teoh (1994:74) assumes that they possess an underlying representation with an extra empty/featureless X-slot (i.e.  $/-Xan/$  and  $/-Xi/$ ). According to him, this is in compliance with his basic claim that every underlying syllable in Malay is CV(C), that is, every syllable must have an onset. As noted, this empty onset X-slot then gets its melodic content from the preceding high vowels through spreading of the  $[+high, \alpha back]$  features. Since the melody is realised in the onset of the syllable, it appears as a 'glide'.

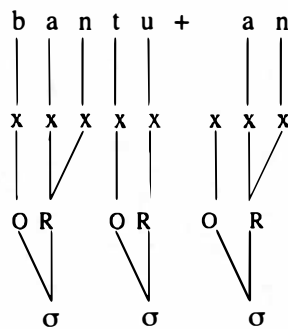
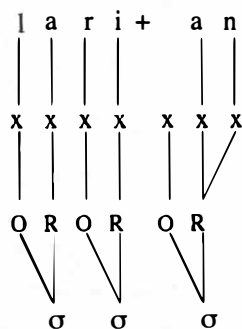
Although Glide Insertion and Glide Formation are characterised by the same process of feature spreading, there is a significant phonological difference between them. In the former, there is no underlying empty X-slot postulated in the input, and the epenthetic 'glide' is inserted to break up the underlying hiatus. Although the rule of Devocalisation is applicable in this environment, this is ruled out by the syllable structure constraint which prohibits complex clusters in the onset.

In Glide Formation there is an underlying empty X-slot between the vowel clusters which requires a melodic segment in order to be realised. This requirement is fulfilled by the process of feature spreading from the preceding segment.<sup>20</sup> The derivation in (47) illustrates this effect.

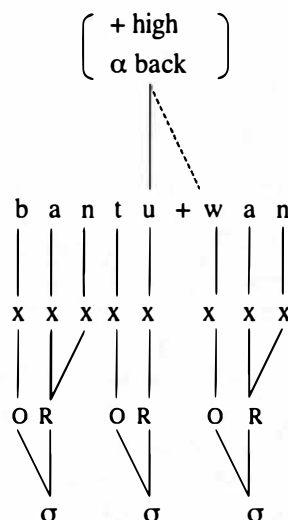
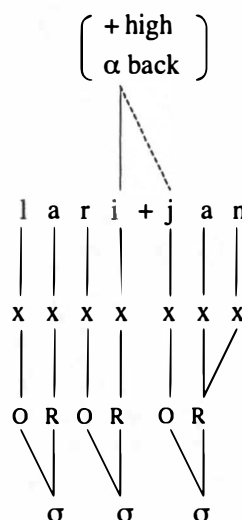
<sup>20</sup> Teoh (1994:75) notes that this would also account for all the geminated forms of stems ending in a consonant other than a voiceless velar stop when suffixed with  $/-Xan/$  or  $/-Xi/$ . How these phenomena are accounted for within the OT framework will be pursued in chapter three.

## (47) Glide Formation — spreading of [+high, α back] features

## a. Underlying melodies with syllabification



## b. Feature spreading



As can be readily seen in (47), it is the empty X-slot that triggers the spreading due to the general principle that every slot at the X-tier must be filled with melodic materials in order to be realised in surface representation. By contrast, the spreading in (46) applies without any such slot. The discrepancy in (46) and (47) demonstrates that Teoh's account is inconsistent and incompatible, particularly with respect to the postulation of the underlying forms. The representation in (47) complies with his primary claim that every underlying syllable must have an onset, but (46) does not. Due to this shortcoming, in his later work Teoh (1989b) postulates that the 'glides' constitute part of the underlying representation. Thus, the forms in (46) are represented as /sijap/ and /buwah/, respectively. One notable comment about this representation is that it misses an important generalisation about the fact that the occurrence of 'glides' in Malay is highly predictable and non-distinctive.

## 2.4 ONSET violation: ALIGN-LEFT and CONTIGUITY

We have observed that Malay disfavours an onsetless surface syllable: underlying hiatus with pre-, post-, and intervocalic high vowels is resolved by parsing the high vocoids to the

syllable margins, and in the case where such a parsing is inapplicable, the hiatus is resolved by C-epenthesis. Apparently, however, ONSET is a dominated constraint, and thus it is violable. There are two instances where ONSET is violated in this language, namely at word initial and root medial environments. The violation of ONSET is the result of respecting a more dominant constraint in the hierarchy.

Let us first examine the case of ONSET violation word initially. As noted in McCarthy and Prince (1993a, 1993b), it is quite common cross-linguistically for languages that otherwise demand strictly C-initial syllables to admit V-initial words. As observed in Farid (1980) and Yunus (1980), the initial syllable of Malay words can be onsetless. Seemingly, this is the evidence that corroborates their claim that the basic syllable structure of Malay is (C)V(C). In (48), we lay out some examples which show that all the six underlying vowels can occur in this environment.

(48)	/ubah/	[ubah]	'to change'
	/indah/	[indah]	'beautiful'
	/elok/	[eloʔ]	'pretty'
	/olah/	[olah]	'to beguile'
	/aŋkat/	[aŋkat]	'to lift'
	/əmak/	[əməʔ]	'mother'

As was demonstrated in (14), when V-initial stems combine with the V-final prefixes, such as /sə-/ , /kə-/ and /di-/ , the underlying vowel sequences /V+V/ at the prefix juncture cannot be parsed heterosyllabically as [V.V], as it produces an onsetless syllable which disobeys ONSET. This is then resolved by Glottal Epenthesis, and the price is a DEP-IO<sub>CONS</sub> violation.

On the other hand, when those stems concatenate with consonant-final prefixes, such as /bəɾ-/ , /təɾ-/ , /məŋ-/ and /pəŋ-/ , the onsetless stems then get their onset from the preceding consonant in accordance with the Minimal Onset Satisfaction Principle (Roca 1994). In this case, ONSET can be fully satisfied without violating the faithfulness constraint DEP-IO<sub>CONS</sub>.

(49) a. Vowel-final prefixes + Vowel initial stems

/di + ubah/	[di.ʔu.bah]	'to change (passive)'
/sə + indah/	[sə.ʔin.dah]	'to be as beautiful as'
/kə + indah + an/	[kə.ʔin.dah.han]	'beauty'
/sə + elok/	[sə.ʔe.loʔ]	'to be as pretty as'
/di + olah/	[di.ʔo.lah]	'to beguile (passive)'
/di + aŋkat/	[di.ʔaŋ.kat]	'to lift (passive)'
/dʒuru + atfara/	[dʒu.ru.ʔa.tʃa.rə]	'master of ceremony'

b. Consonant-final prefixes + Vowel initial stems

/məŋ + indah + kan/	[mə.ŋin.dah.kan]	'to beautify'
/pəŋ + aŋkat/	[pə.ŋaŋ.kat]	'lifter (instrument)'
/təɾ + elok/	[tə.re.loʔ]	'most beautiful'
/məŋ + ubah/	[mə.ŋũ.bah]	'to change (active)'
/bəɾ + aŋkat /	[bə.raŋ.kat]	'to depart'

As shown in (48), Malay freely tolerates onsetless syllables word initially. Although Glottal Epenthesis is potentially active as an alternative way to satisfy ONSET, this solution does not seem to be preferred in this particular environment. The violation of ONSET in

V-initial stems is common in many languages, such as in Timugon Murut (Prentice 1971; McCarthy & Prince 1993ab), Tagalog and Axininca Campa (McCarthy & Prince 1993ab), and so it is not a mere fluke in Malay.

In McCarthy and Prince's (1993ab) analysis of Axininca Campa, the V-initial phenomenon arises from the interaction of ONSET and ALIGN-LEFT (50), an alignment constraint of prosody-morphology interface which requires that the left edge of any stem must coincide with the left edge of a PrWd (Prosodic Word). ALIGN-LEFT is unviolated, and therefore it is undominated in the constraint hierarchy of Axininca Campa. ONSET is violated when it conflicts with ALIGN-LEFT, and the ranking is ALIGN-LEFT >> ONSET.

(50) ALIGN-LEFT (McCarthy & Prince 1993b)

Align (Stem, L, PrWd, L)

It is apparent that the interaction ALIGN-LEFT >> ONSET can handle a similar phenomenon in Malay. However, in order to account for the Malay data adequately and satisfactorily, I will adopt a different definition of ALIGN-LEFT, as formalised in (53).

ALIGN-LEFT belongs to a family of well-formedness constraints, called GENERALISED ALIGNMENT (henceforth GA), which is formalised in McCarthy and Prince (1993b) as in (51).

(51) GENERALISED ALIGNMENT (McCarthy & Prince 1993b:80)

Align (Cat1, Edge1, Cat2, Edge2) = <sub>def</sub>

$\forall$  Cat1  $\exists$  Cat2 such that edge1 of Cat1 and Edge2 of Cat2 coincide.

Where

Cat1, Cat2  $\in$  Pcat  $\cup$  Gcat

Edge1, Edge2  $\in$  {Right, Left}

GA requires that a designated edge (i.e. left or right) of each prosodic or morphological constituent (i.e. Pcat and Gcat) of type Cat1 coincide with a designated edge (i.e. left or right) of some other prosodic or morphological constituent (i.e. Pcat and Gcat) Cat2.<sup>21</sup> As demonstrated in McCarthy and Prince (1993b), GA is able to express a wide range of reference to edges in the grammar of many languages via various types of alignment constraints. For instance, to account for stress pattern in Garawa, two alignment constraints are proposed, namely ALIGN-PRWD — Align (PrWd, L, Ft, L), and ALIGN-FT — Align (Ft, R, PrWd, R); Tagalog prefixation requires ALIGN-um — Align ([um]<sub>Af</sub>, L, Stem, L); Ulwa suffixation needs ALIGN-TO-FOOT — Align ([Poss]<sub>Af</sub>, L, Ft, R).

It is important to note that the term 'edge' in Alignment theory is interpreted as relational rather than categorical. According to McCarthy and Prince (1993b:89), "the notion that we really need is relational, something like 'sharing an edge', rather than categorical, referring to edge *per se*. Two categories are aligned when they 'share an edge', and the Alignment constraint specifies the categories and which side of each is involved in 'sharing an edge'".

Now let us examine the V-initial phenomenon in Malay as shown in the data (48). Observe how, in the following examples, an onsetless syllable guarantees coincidence between the word stem and the edge of a syllable. While, Glottal Epenthesis locates the morphological word edge inside a syllable. The relevant word-edge is marked by ' | ' and the syllable boundary is shown by a full stop ' . '.

<sup>21</sup> Gcat = Grammatical Category, among which are the morphological categories Mcat = Root, Stem, Morphological Word, Prefix, Suffix, etc. Pcat = Prosodic Categories =  $\mu$ ,  $\sigma$ , Ft, PrWd, PhPhrase, etc. (McCarthy & Prince 1993a).



## (52) Word-Syllable Alignment

Input: /ubah/

Output: a. [·|u.bah]

b. \*[·?|u.bah]

c. \*[·|&lt;u&gt;.bah]

The distinction between matching and non-matching of word/syllable edges in (52) is regulated by a formal constraint called ALIGN-LEFT, which is formally defined in this study as in (53).

## (53) ALIGN-LEFT


Align (Word, Left,  $\sigma$ , Left)

Unlike (50), constraint (53) says that the left edge of any morphological word must coincide with the left edge of a syllable. I will show in Chapter 4 that ALIGN-LEFT defined in McCarthy and Prince (1993), as in (50) does not work for Malay.

In order for ALIGN-LEFT to be fully satisfied, the V-initial word must be parsed with an ONSET violation. If epenthesis were to apply, the presence of C-epenthetic segment which is not part of the morphological word will shift the syllable edge away from the word edge (52b). This causes a misalignment of the leading edges of the syllable and the word. Equivalently, deleting the initial vowel, a MAX-IO<sub>VOW</sub> violation, as a way to avert an ONSET violation, can never bring a form into agreement with ALIGN-LEFT (52c) (cf. McCarthy & Prince 1993a, 1993b).

In short, obedience to ALIGN-LEFT can only be achieved, if the word-initial segments, vowels or consonants, occupy the word initial position. ALIGN-LEFT is unviolated, and therefore it is undominated in the constraint hierarchy. When ALIGN-LEFT conflicts with ONSET, inevitably the latter has to give way. This suggests that the ranking is ALIGN-LEFT, MAX-IO<sub>VOW</sub> >> ONSET >> DEP-IO<sub>CONS</sub>. The following tableau clarifies the arguments I just made.

(54) ALIGN-LEFT, MAX-IO<sub>VOW</sub> >> ONSET >> DEP-IO<sub>CONS</sub>

/ubah/	ALIGN-LEFT	MAX-IO <sub>VOW</sub>	ONSET	DEP-IO <sub>CONS</sub>
a.   u.bah			*	
b.  < >.bah	*!	*		
c. .? u.bah	*!			*

As can be seen, in the losing candidates (54b) and (54c), the word edge and the syllable edge do not coincide due to deletion (as shown by '< >') or the presence of epenthetic an glottal stop. In contrast, the optimal candidate (54a) is well-aligned, but minimally violates the syllable structural constraint ONSET.

Although ONSET can be violated in the bare forms, the situation is totally different in the prefixed forms, particularly in the case where V-final prefixes concatenate with V-initial stems (49a). The initial vowel of the stem appears in a word internal position, thus, ALIGN-LEFT is irrelevant and vacuously satisfied. Glottal Epenthesis then has to apply in compliance with the ONSET requirement.

(55) ALIGN-LEFT, MAX-IO<sub>VOW</sub> >> ONSET >> DEP-IO<sub>CONS</sub>

/di+ubah/	ALIGN-LEFT	MAX-IO <sub>VOW</sub>	ONSET	DEP-IO <sub>CONS</sub>
a. . di.u.bah			*!	
b. . du.bah		*!		
c. ʔ . di.ʔu.bah				*

All the candidates satisfy ALIGN-LEFT, since the edges of the word and the syllable coincide. The next constraints that should be consulted are MAX-IO<sub>VOW</sub> and ONSET, which then rule out (55a) and (55b) respectively. Although the optimal candidate (55c) violates DEP-IO<sub>CONS</sub>, this is irrelevant, since the victor has already been determined.

In the case where C-final prefixes concatenate with V-initial stems, obviously the rule of Glottal Epenthesis is not required. The final consonant of the prefix is readily available to fulfil the minimal ONSET requirement. Thus, the optimal candidate fully satisfies all the four given constraints. The following tableau demonstrates this fact.

(56) ALIGN-LEFT, MAX-IO<sub>VOW</sub> >> ONSET >> DEP-IO<sub>CONS</sub>

/mən+ubah/	ALIGN-LEFT	MAX-IO <sub>VOW</sub>	ONSET	DEP-IO <sub>CONS</sub>
a. . mən.u. bah			*!	
b. . mən.ʔu.bah				*!
c. ʔ . mən.ʔu.bah				

In conclusion, the emergence of a glottal stop preceding the V-initial stem in the prefixed forms is motivated by the wellformedness condition on syllable structure which requires that every syllable must have an onset. However, when the V-initial stems occur in isolation as independent words, Glottal Epenthesis can never apply due to the dominant ranking of ALIGN-LEFT. This readily explains the phonological alternation that has taken place.

In Farid's linear analysis (1980:48–50), the phenomenon of Glottal Epenthesis is captured by a rule called Glottal Insertion Rule, which is formalised as in (57).<sup>22</sup>

(57)  $\emptyset \rightarrow ? / V - \_\_ V$ 

Condition: '-' designates a prefix boundary

In his multilinear analysis, Teoh (1994) suggests that the glottal stop at the prefix juncture is not rule-derived, but underlyingly present in the stems. Teoh (1994:89) writes,

... vowel-initial stems may be pronounced optionally either with or without the glottal stop when in isolation and that the same glottal stop resurfaces obligatorily when vowel-initial stems are prefixed to the vowel-final passive marker /di-/. In order to solve this particular problem we have again assumed the [ʔ] as underlying in all so-called vowel-initial stems.

<sup>22</sup> According to Farid (1980:49), the rule of Glottal Epenthesis also applies between two identical vowels morpheme internally (i.e. /saat/ 'seconds' and /peel/ 'behaviour' become [saʔat] and [peʔel]). Teoh (1994:86) denies this, and takes the position that these words are borrowed from Arabic with the voiced pharyngeal fricative [ʕ] occurring in the medial position, and this consonant is replaced by [ʔ] in Malay. I am in agreement with Teoh in this respect.

Postulating the glottal stop as an underlying segment word initially in the so-called vowel-initial stems (i.e. /ʔubah/, /ʔindah/) is in compliance with his primary claim that no syllable in this language can begin with a vowel, as it is constrained by the syllable typology CV(C) of the language.

In supporting his analysis about the presence of underlying glottal stop word initially, Teoh (1994) offers a piece of language external evidence extracted from a language game inverting the syllables of each stem. For example, forms such as /batu/ 'stone' or /satu/ 'one' will be transformed into [tuba] and [tusa] respectively. However, for vowel-initial stems, such as /aku/ 'I' and /apa/ 'what', these words are inverted and rendered as [kuʔa] and [paʔa], and not as \*[kuwa] and \*[paa] which is what one would expect to be. The alternation in the language game can be accounted for more generally and simply if the glottal stop is postulated as part of the underlying representation (i.e. /ʔaku/ and /ʔapa/).

Given the facts of Malay, Teoh's analysis misses two important phonological generalisations. First, he fails to capture the regular process of cross-morphemic syllabification at the prefix-stem juncture which is motivated by the principle of Minimal Onset Satisfaction (Steriade 1982; Selkirk 1982; Clements & Keyser 1983; Hyman 1985; Itô 1986; Roca 1994). This is represented in (49b) where the prefix-final consonant is syllabified in the onset of the following stem. In Teoh's analysis, a possible way of accounting for this fact is through a rule that first deletes the stem-initial glottal stop, followed by the resyllabification rule. Obviously, such a solution introduces complexity in the grammar, and therefore it should be discarded.

Second, it is observed that the so-called underlying glottal stop only occurs in this specific location and never in any other word positions. When this restrictional distribution is taken into account, then the phonemicity of the glottal stop becomes precarious and suspicious. It is worth noting that the occurrence of a glottal stop in other environments, such as in the stem syllabic coda and in the onset at the suffix boundary is not lexical, but derived via Debuccalisation (see §2.5.1) and Glottal Epenthesis (see §3.2.1), respectively. Surely also the language games data can be understood in terms of epenthesis anyway.

In contrast to Teoh, I assume that the so-called vowel initial stems lexically begin with vowel segments. This suggests that Malay basic syllable structure can be onsetless. The occurrence of a glottal stop in the intervocalic position at the prefix juncture is interpreted as a result of C-epenthesis, which is phonologically motivated as a resolving 'mechanism' for breaking up the hiatus (cf. Farid 1980; Durand 1987; McCarthy & Prince 1993b).

Another case that involves a violation of ONSET is within the root domain. The examples in (58) illustrate this situation.<sup>23</sup>

(58)	/kaen/	[ka.en]	'cloth'
	/naek/	[nã.ẽʔ]	'to ascend'
	/maen/	[mã.ẽn]	'to play'
	/haos/	[ha.os]	'thirsty'
	/laot/	[la.ot]	'sea'

Notice that the underlying vowel sequences are parsed heterosyllabically preserving the hiatus in the surface output, a clear violation of ONSET. Apparently, ALIGN-LEFT is irrelevant in this context, since the position occupied by the onsetless syllable is not at the word edge. Given the schematic ranking ONSET >> DEP-IO<sub>CONS</sub> established thus far, we

<sup>23</sup> Neither *k ~ ʔ* alternation nor Vowel Nasalisation are relevant here. They will be discussed in detail in §2.5.1 and §4.6, respectively.

would expect the rule of epenthesis will generally apply to resolve the conflict. Nevertheless, this is not the case here. This suggests that the preservation of hiatus root internally must be due to some other formal constraint. Before we identify that particular constraint, it is important to note that there is a disagreement among linguists with respect to both the input and the output representations of the data in (59).

(59) a. Yunus (1980)

/kain/	[ka.en]
/naik/	[na.eʔ]
/laut/	[la.ot]

b. Farid (1980)

/kain/	[kaɛn]
/naik/	[naɛʔ]
/laut/	[laqt]

c. Durand (1987)

/kain/	[ka.jn]
/naek/	[na.jk]
/laut/	[lawt]

d. Teoh (1994)

/kaʔin/	[ka.ʔen]
/naʔek/	[na.ʔeʔ]
/laʔut/	[la.ʔot]

In Yunus (1980), Farid (1980) and Teoh's (1994) analyses, the underlying high vowels /i, u/ in the closed final syllable are lowered to [e, o], respectively, by the so-called Vowel Lowering. I shall argue in §2.6 that this rule is not phonologically motivated, and therefore it is preferable to represent the underlying vowel as a mid-vowel.

Notice that in Farid's description the derived mid-vowels [e, o] are syllabified in the margin via Marginal Vowel Derived Rule (38), whereas in Yunus and Teoh's they are syllabified in the nucleus. As far as the syllable position of mid-vowels is concerned, I agree with Yunus and Teoh's description. As previously commented, the parsing of the mid-vowels in the margin creates complex codas, and this runs against the basic syllable structure (C)V(C) proposed in Farid (1980:24).

In Durand (1987), the high vowels in closed final syllable do not get lowered into [e, o]. They remain as high vowels, but are tautosyllabically parsed in the rhyme, giving rise to complex codas as in Farid (1980). According to Durand (1987:98), the Malay syllable template allows for complex onsets and codas. This assumption contradicts the general view that the basic structure of the Malay syllable is simplex (cf. Yunus 1980; Farid 1980; Teoh 1994).


Contrary to Farid (1980) and Yunus (1980), Teoh's (1994) surface forms contain an intervocalic glottal stop. This interpretation is observationally inadequate. To best of my knowledge, no varieties of Malay have a glottal stop in that position. Based on my observation, I agree with Yunus's (1980) analysis that the input vowel sequences in (56) are parsed heterosyllabically, preserving the hiatus in the surface output. This observation is further supported by psychological evidence from the same language game, as discussed earlier, which involves syllable reversing in a stem. Thus, words like [nã.ẽʔ] and [la.ot] are reversed into [ẽʔ.nã] and [ot.la].

We have observed that tautosyllabification and C-epenthesis are two general mechanisms that the language employs in order to break up an underlying hiatus. However, for the case under discussion, neither of them is applicable. In what follows, we attempt to determine the relevant constraints that rule out these two possibilities.

First, let us consider tautosyllabification. As mentioned, not any vowel sequence in Malay can be syllabified tautosyllabically, but only sequences that end with a high vowel. To exclude tautosyllabic sequences of non-high vowels, a sonority constraint called SONFALL (32) is imposed requiring that tautosyllabic vowel sequences must have a decrease in sonority (Rosenthal 1994). To put it simply, the sonority of the first vowel must be greater than the sonority of the second vowel.


When the mid-vowels in /kaen/ and /laot/ are parsed tautosyllabically, this also violates \*COMPLEX, which militates against the occurrence of two or more segments in any one of the syllabic node, and in this particular case is in the rhyme. Both SONFALL and \*COMPLEX are undominated constraints, and they rule out a tautosyllabified candidate, as illustrated in tableau (60).

- (60) Onsetless syllable root internally: \*COMPLEX, SONFALL >> ONSET

/kaen/	*COMPLEX	SONFALL	ONSET
a. kaēn	*!	*	
b.  ka.en			*


It is also worth noting that unlike, the high vowels /i, u/, the low vowel /a/ cannot be parsed ambiskeletonally in the margin, because it is the most sonorous segment (cf. McCarthy & Prince 1993a; Rosenthal 1994). In our study, this prohibition is governed by a syllable structure constraint \*M/NH (22), which is also unviolated in the language. This constraint rules out the possibility of the low vowel undergoing an ambiskeletal parsing.

- (61) \*COMPLEX, SONFALL, \*M/NH >> ONSET

/kaen/	*COMPLEX	SONFALL	*M/NH	ONSET
a. kaɣn	*!	*		
b. ka.ɣen			*!	
c.  ka.en				*

Now, we turn to the process of C-epenthesis. We have seen that Glottal Epenthesis (14) is used to resolve underlying hiatus at the prefix-stem juncture. We then established the schematic ranking MAX-IO<sub>vow</sub> >> ONSET >> DEP-IO<sub>cons</sub>, as demonstrated in (16). However, this ranking fails to account for the phenomenon under discussion, since it yields an incorrect result, as the following tableau shows.

- (62) MAX-IO<sub>vow</sub> >> ONSET >> DEP-IO<sub>cons</sub>

/kaen/	MAX-IO <sub>vow</sub>	ONSET	DEP-IO <sub>cons</sub>
a. ☺ ka.en		*!	
b.  *ka.ʔen			*
c. kan	*!		

As can be seen, (62b) is chosen as the optimal candidate, as it minimally violates the lower-ranked constraint DEP-IO<sub>CONS</sub>. Nevertheless, the correct surface form is (62a), the candidate marked by '☺'. This means that there must be another constraint which is crucially involved in evaluating these candidates, and this constraint definitely must be ranked higher than ONSET. The relevant constraint that plays a significant role here is CONTIGUITY, which demands that the input and the output strings must be contiguous.

It has been observed that, in most languages, there are many phonological processes that typically apply at the edge of a grammatical constituent rather than internal to one. For examples, in Axininca Campa and Lardil, epenthetic augmentation is external to the root (McCarthy & Prince 1993a); in Chukchee, morpheme-edge epenthesis is favoured than morpheme-internal epenthesis (Kenstowicz 1994c; Spencer 1993); in Diyari, a prohibition on syllable codas causes all consonants to be deleted word finally, but not word medially. This situation is captured by a general constraint called CONTIGUITY, which is defined in McCarthy and Prince (1995b) as follows:

(63) CONTIGUITY

I-CONTIG ('No Skipping')

The portion of  $S_1$  (input) standing in correspondence forms a contiguous string.

O-CONTIG ('No Intrusion')

The portion of  $S_2$  (output) standing in correspondence forms a contiguous string.

The constraints in (63) distinguish two types of contiguity. The constraint I-CONTIG rules out internal deletion in the input string. For instance, when a string /abc/ surfaces as [ac], this violates I-CONTIG because ac is not a contiguous string. This constraint, however, is not violated if the deletion rule applies at the edge, as in /abc/ → [ab], because ab is a contiguous string. Likewise, the violation of O-CONTIG is compelled if epenthesis were to apply internally to the input string, such as /ac/ → [abc]. By contrast, epenthesis at the edge, such as /ab/ → [abc] does not. For present purposes, we don't need to distinguish these two constraints. Both epenthesis and deletion will be controlled by a single general constraint called CONTIGUITY.


The question is, does Glottal Epenthesis in Malay violate CONTIGUITY? The answer can either be yes or no, depending on the grammatical constituent which constitutes the domain of the application of the rule. CONTIGUITY is violated at the word level, since the rule applies internally to the word domain. However, at the root level, CONTIGUITY is fully satisfied, since the epenthesis rule only applies at the edge of the root domain.

It has been commonly observed that a large number of disparate phonological phenomena are subject to stricter faithfulness requirements within the root than elsewhere in the word, that is, from the relative markedness of roots (cf. McCarthy & Prince 1995b). The greater markedness of roots is undoubtedly driven by the demand to sustain more contrasts between roots than between affixes. McCarthy and Prince (1995b) formalise this difference in markedness by proposing a general ranking schema in which root-specific versions of faithfulness constraints are intrinsically ranked higher than the general, or affix-specific version of the same constraint.

Considering the case under discussion, we need a root-specific constraint of CONTIGUITY called ROOTCONTIG which bans root-internal epenthesis and deletion. ROOTCONTIG is an unviolated constraint in Malay, therefore it cannot be dominated in the hierarchy. The relevant ranking to account for ONSET violation root internally is as follows: \*COMPLEX, \*M/NH, SONFALL, ROOTCONTIG >> ONSET >> DEP-IO<sub>CONS</sub>.



## (64) Onsetless syllable root internally (final version)

/kaen/	*COMPLEX	*M/NH	SONFALL	ROOT CONTIG	ONSET	DEP- IO <sub>CONS</sub>
a. kaɣn	*!		*			
b. ka.ɣen		*!				
c. ka.ʔen				*!		*
d. kan				*!		
e.  ka.en					*	

It must be noted that the ruled out candidate (64d) violates the undominated constraint MAX-IO<sub>VOW</sub> as well. It is evident now, despite the fact that ONSET is highly ranked, it is simply being disobeyed in this particular environment basically because other possible means, such as tautosyllabification (64a), ambiskeletal parsing (64b), Glottal Epenthesis (64c) and Vowel Deletion (64d) fatally violate the undominated constraints \*COMPLEX, \*M/NH and ROOTCONTIG respectively. Since there are no other possible competitors in the set, the candidate with ONSET violation (64e) emerges as the winner.

In conclusion, the reason why ONSET can be violated word initially and root internally is that this is the most harmonic way to assure that the undominated constraints are satisfied. The fact that Malay syllables can be onsetless disposes of Teoh's (1994) strong claim that every syllable in this language must begin with an onset.

## 2.5 Syllable structure: CODA COND

We have observed that Malay syllables may have a single member coda. Nevertheless, there is a restriction in the language which prohibits a small class of segments from occupying the coda position. In the phonological analysis of syllable structures, the prohibition of some segments in the coda is governed by the Syllable Coda Condition (Itô 1986), which has usually been conceived of as a negative condition ruling out particular configurations syllable-finally.

Following Itô (1986), Teoh (1994) postulates the Syllable Coda Condition of Malay in (65), which states that the segments specified [-anterior] are barred from occupying the coda of a syllable.

- (65)            \*C]<sub>σ</sub>  
                   |  
                  [- anterior]

According to Teoh (1994:58), the constraint in (65) bars /tʃ, dʒ, ɲ/ from codas, except in very few loan words, such as [matʃ] 'march' and [koledʒ] 'college' (Yunus 1980:69, Farid 1980:13). As pointed out by Teoh (1994:58), the occurrence of homorganic clusters [ɲdʒ] and [ɲtʃ] in words such as [paɲdʒat] 'to climb' and [məɲtʃari] 'to find' is not construed as violating this constraint, because homorganic clusters are treated as partial geminates and therefore they have doubly-linked representations. By invoking Hayes's (1986) Linking Constraint, which requires that all association lines present in rules be interpreted exhaustively, the Syllable Coda Condition for Malay as stated above does not apply to doubly-linked structures. It must be pointed out that Constraint (65) also bans /g, k, r, ɳ, h/

from syllable codas, since they are specified with [-anterior] feature in Teoh's (1994:53) feature matrix. This is not correct, because both /ŋ/ and /h/ can occur in the coda position.

In addition to the absence of /tʃ, dʒ, ɲ/, there is another significant observation in the syllable coda not captured in Teoh's (1994) Syllable Coda Condition. This involves phonological alternations such as deletion and feature changing rules which effect some class of segments, namely the voiceless velar stop /k/, the voiced obstruents /b, d, g/ and the liquid /r/. As far as the Syllable Coda Condition is concerned, this phonological behaviour is more relevant, particularly in the context of the points made by Blevins (1995:228), who states that

Wherever possible, coda constraints should be supported by positive evidence from native and loan phonology in the form of stray erasure, extraprosodicity, feature changing rules, or epenthesis triggered by arguably illicit coda segments. Only in such cases is there positive evidence of the systematic nature of gaps in the coda inventory.

If such supportive evidence is crucial, the effect of the Syllable Coda Condition and the prohibition of /tʃ, dʒ, ɲ/ in the coda then becomes suspicious. It is apparent that their absence in the native vocabulary is purely accidental. There is no positive evidence to support this distributional constraint. In short, Teoh's (1994) description on the Syllable Coda Condition of Malay is not satisfactory.

In what follows, I attempt to show more tangible effects of the Syllable Coda Constraint, supported by positive evidence from native and loan phonology in the form of feature changing mechanisms (i.e. feature delinking and feature spreading) and segmental deletion. These strategies are used to resolve illicit coda segments.

In the earlier OT analysis, the Syllable Coda Condition is governed by a formal constraint generally referred to as CODA COND and defined in prose. For example, CODA COND for Axininca Campa (McCarthy & Prince 1993a, 1994) is as follows.

(66) CODA-COND

A coda consonant is a nasal homorganic to a following stop or affricate

This constraint has been reinterpreted and reformalised in terms of an alignment statement requiring consonants to be left-aligned with a syllable (Itô & Mester 1994), as formally defined in (67) below.

(67) CODA COND: Align-Left (C, σ)

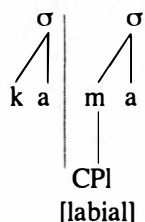
The formulation in (67) generally implies that all consonants are ruled out from syllable final position. In concrete cases, however, the consonantal element referred to by means of 'C' in (67) is often more narrowly circumscribed by referring to Cplace, marked Cplace, major segment types (resonant, obstruents), etc., and in this way CODA COND (67) is, properly speaking, an alignment scheme that in individual grammars is cashed in for some set of elementary alignment conditions (Itô & Mester 1994:31). For instance, CODA COND for Japanese is formalised in terms of an alignment constraint by Itô and Mester (1994) as in (70), which requires a consonantal place node to occupy the left periphery of a syllable.

(68) CODA COND: Align-Left (Cplace, σ)

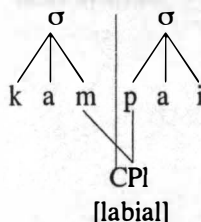
As I have mentioned, CODA COND is subject to the Linking Condition (Hayes 1986; Itô 1986, 1989). Any segment which is doubly-linked to both rhyme and onset is immune to this constraint. Thus, geminates and place-linked clusters are not counted as a violation of CODA COND. Itô and Mester (1994:34) call this 'noncrisp alignment', as opposed to the 'crisp' one. Consider the following representations in Japanese (Itô & Mester 1994).



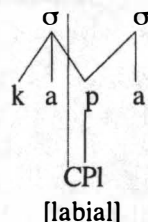
(69) a. kama 'kettle'



b. kampai 'cheers'



c. kappa 'water imp'



The CPlace in (69a) fulfils CODA COND (68), since it is exclusively linked as a leftmost syllable daughter ('Crisp alignment'). And the CPlace in (69b) and (69c) also satisfy CODA COND, as it is linked to the left edge of the second syllable, in spite of the additional link to the preceding syllable ('noncrisp alignment') (cf. Itô & Mester 1994).

As was mentioned, illicit coda segments are generally resolved by three different strategies namely V-epenthesis, C-deletion and feature changing mechanisms (i.e. feature delinking and spreading). For example, V-epenthesis is used to resolve CODA COND in Bedouin Arabic and Biblical Hebrew, which prohibits pharyngeal consonants in coda position (McCarthy & Prince 1993b; Itô & Mester 1994). A violation of DEP-IO<sub>CONS</sub> is compelled by the satisfaction of CODA COND, suggesting the ranking CODA COND >> DEP-IO in those languages.

A case of C-deletion is demonstrated in the Eastern Massachusetts dialect reported in McCarthy (1993). In this dialect, the consonant /r/ never occurs preconsonantly or utterance-finally. The loss of etymologic /r/ in these environments is triggered by CODA COND, and this constraint crucially dominates MAX-IO in that variety.

Other repair strategies of CODA COND violations are feature spreading and delinking. Typical cases of such mechanisms are Voicing Assimilation and Laryngeal Neutralisation (Lombardi 1995). In many languages, laryngeal distinctions are lost syllable-finally. For instance, in German voiced obstruents are devoiced syllable-finally. In this case the satisfaction of CODA COND is achieved by delinking the feature [laryngeal] of the input. The consequence of feature delinking is a violation of the IDENT-IO[F] constraint family, which demands that the correspondent of the input segment specified as [F] must be [F].<sup>24</sup>

As far as Malay is concerned, illicit coda segments are resolved by three general strategies, namely feature delinking, feature spreading and C-deletion. These are manifested in four different phonological alternations, called Debuccalisation, Obstruent Devoicing, Nasal Assimilation and r-Deletion. To account for these, I propose that Malay requires more than one CODA COND constraint, all subsumed under the CODA COND constraint family. As suggested in Prince and Smolensky (1993), a constraint family is a group of similar and related constraints are built around a single broad concept (e.g. Faithfulness, sonority), but are still separately rankable in the constraint hierarchy.

### 2.5.1 ALIGN-STOP(K): Debuccalisation

The voiceless velar stop /k/ has two phonetic realisations depending on its position in the syllable structure; [k] occurs in the onset, and a glottal stop [ʔ] occupies the coda. The wider distribution of the velar stop as compared to glottal stop generally leads to the postulation of

<sup>24</sup> In the PARSE/FILL approach of earlier OT (Prince & Smolensky 1993), feature delinking is construed as a violation of a PARSE(F) constraint. In the case of laryngeal neutralisation, the relevant constraint is PARSE (Laryngeal) (cf. Lombardi 1995).

the former as the basic underlying form (Yunus 1980; Farid 1980; Teoh 1994). In terms of rule-based approach, the change of the stop obstruent /k/ into [ʔ] in the syllable coda is referred to as a process of Debuccalisation.<sup>25</sup> Some relevant examples are listed below.

(70)	/saksi/	[saʔsi]	'witness'
	/laksa/	[laʔsa]	'a kind of noodle'
	/sepak/	[sepaʔ]	'to kick'
	/baek/	[baeʔ]	'good'
	/kakak/	[kakaʔ]	'sister'
	/kapak/	[kapaʔ]	'an axe'

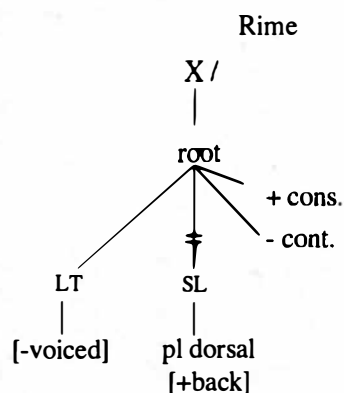
In previous studies the process of Debuccalisation is commonly known as Glottal Formation (Farid 1980; Teoh 1994). This process occurs in many languages, such as Toba Batak (Hayes 1986b), which converts all voiceless stops in coda position to a glottal stop, and the New York City English and Scottish dialects, which replace oral stop [t] to [ʔ] (Lass 1976).

Glottal Formation is formulated in Farid (1980:9) as in (71). Following Sagey's (1986) feature representation, this rule is reinterpreted in Teoh (1994:74) as in (72) which is seen as the result of the delinking of the supralaryngeal node of the velar stop at syllable coda position, leaving only the laryngeal node linked to the root node.

(71) Glottal Formation (Farid 1980:9)

$$k \rightarrow ? / \_\_ \{ \#, C \}$$

(72) Glottal Formation (as delinking) (Teoh 1994:74)



Both these rules lack explanatory adequacy, as they only describe the phenomenon, without providing an explanation for what motivates such a rule. In our analysis, Debuccalisation is construed as a mechanical strategy to avoid the violation of the CODA COND constraint. Following Itô and Mester (1994), the CODA COND constraint for the voiceless velar stop is ALIGN-STOP(K), the alignment constraint requiring the velar stop /k/ to be left-aligned with a syllable, as formally defined in (73).

<sup>25</sup> In the Kelantan and Terengganu dialects of Malay, this rule affects all the voiceless stops /p, t, k/. Thus, the rule is more general in these dialects (see Teoh 1994; Trigo 1991).

- (73) ALIGN-STOP(K)  
Align-Left (k,  $\sigma$ )

The constraint in (73) demands that the consonant /k/ must be an onset. One way of eschewing a violation of ALIGN-STOP(K) is by feature delinking. The consequence of this is a violation of the featural faithfulness IDENT-IO[F] constraint family, which demands that the correspondent of the input segment specified as [F] must be [F] (Pater 1996). In the case of  $k \sim ?$  alternation, the relevant constraint at play is IDENT-IO[Dorsal].



It has been generally claimed that Debuccalisation basically involves the delinking of the place node (McCarthy 1988). To capture this generalisation, I employ a formal constraint IDENT-IO[Place],<sup>26</sup> formally defined in (74).

- (74) IDENT-IO[Place]

The correspondent of the input segment specified as [Place] must be [Place].

ALIGN-STOP(K) and IDENT-IO[Place] conflict with each other, and the schematic ranking in the former must dominate the latter, as the following tableau demonstrates.

- (75) Debuccalisation: ALIGN-STOP(K) >> IDENT-IO[Place]

/masak/	ALIGN-STOP(K)	IDENT-IO[Place]
a. ma.sak	*!	
b.  ma.sa?		*
/saksi/		
a. sak.si	*!	
b.  sa?.si		*

The failed candidate (75a) violates ALIGN-STOP(K), since [k] occurs in the coda position. By contrast, in the optimal candidate (75b), the coda consonant is [ʔ], and therefore ALIGN-STOP(K) is vacuously satisfied at the expense of violating IDENT-IO[Place]. Other possibilities of feature changing strategies in terms of rule based approach are Spirantisation, where stops become fricatives (i.e. /k/ → [x]), and Deoralisation, where oral stops become nasals (i.e. /k/ → [ŋ]), are ruled out by assuming that the IDENT-IO[Continuant] or IDENT-IO[Sonorant] are ranked higher than ALIGN-STOP(K).

In addition to the feature changing rules, the satisfaction of structural well-formedness can be achieved by vowel epenthesis (i.e. overparsing) and consonant deletion (i.e. underparsing). The price for such parsings are violations of DEP-IO<sub>VOW</sub> and MAX-IO<sub>CONS</sub>, respectively. Deletion is visibly active in this language and this will be explored in §2.5.3.

In the case under discussion, the strategy of consonant deletion is not applicable. This suggests that the possibility must be ruled out by a more dominant constraint in the hierarchy. As we have demonstrated in §2.3, root internal deletion and epenthesis are prohibited in order to respect the undominated constraint ROOTCONTIG. The same explanation goes for a root, such as /saksi/ 'witness', as illustrated in (76), where the satisfaction of ALIGN-STOP(K) by segmental deletion (i.e. \*[sasi]) and epenthesis (i.e. \*[sakəsi]) compels a fatal violation of ROOTCONTIG.

<sup>26</sup> As noted in McCarthy and Prince (1995b), featural faithfulness can refer to distinctive features as well as feature nodes.

- (76) Debuccalisation: ROOTCONTIG >> ALIGN-STOP(K) >> IDENT-IO[Place]

/saksi/	ROOT CONTIG	ALIGN- STOP(K)	IDENT- IO[Place]
a. sak.si		*!	
b. sa.kə.si	*!		
c. sa.si	*!		
d. saʔ.si			*

However, as previously mentioned, the general constraint CONTIGUITY (63) is not violated if the deletion or epenthesis rule applies at the edge (McCarthy & Prince 1995). Following this assumption, ROOTCONTIG becomes irrelevant when deletion or epenthesis applies at the edge of /masak/, yielding possible candidates \*[masa] and \*[masakə] respectively. Since these candidates are not optimal, they must be ruled out by some other dominant constraints.

Recall the alignment constraint called ALIGN-LEFT (53) which requires that the left edge of a word must coincide with the left edge of a syllable. This constraint prohibits word initial epenthesis or deletion, as was illustrated in (54). To account for the prohibition of word final epenthesis and deletion, we need a formal constraint which closely resembles ALIGN-LEFT, namely, ALIGN-RIGHT, which is formally defined as follows:

- (77) ALIGN-RIGHT

Align (Stem, Right,  $\sigma$ , Right)

Constraint (77) states that the right edge of a stem must coincide with the right edge of a syllable. Similarly to ALIGN-LEFT, in order for ALIGN-RIGHT to be fully satisfied, the final segment of the input stem cannot be deleted (i.e. underparsed) or syllabified with an epenthetic vowel (i.e. overparsed). Deletion and Epenthesis will cause a misalignment of the leading edges of the syllable and the stem, as shown in (78). The relevant stem-edge is marked by ' | ', the syllable boundary is indicated by a full stop ' . ', and deletion is shown by '< >'.<sup>10</sup>

- (78) Stem-Syllable Alignment

Input: /masak/      Output:

- \*[ma.sa.< >]
- \*[ma.sa.k|ə.]
- \*[ma.saʔ.]

<Plc>


As can be seen, the effects of C-deletion (i.e. delinking of the root node) in (78a) and V-epenthesis in (78b) have shifted the syllable edge away from the input stem edge, a clear violation of ALIGN-RIGHT. Notice that, although the stem and syllable edges coincide in the optimal form (78c), delinking is also involved: the delinking material is a feature rather than a root node. It has been argued that delinking of features would result in a violation of ALIGN-RIGHT, just as delinking of a root node does. In order for ALIGN-RIGHT to be fully satisfied, all the feature content of the input stem, as well as the root node, must have a correspondent in the output (i.e. faithfully parsed) (cf. McCarthy 1993b; Lombardi 1995).

Unlike ALIGN-LEFT, ALIGN-RIGHT is a dominated constraint in this language. In this particular case, it is outranked by ALIGN-STOP(K). Since all the candidates in (78) violate ALIGN-RIGHT equally, this constraint does not play a crucial role here. Therefore, the elimination of (78a) and (78b) must be due to MAX-IO<sub>CONS</sub> and DEP-IO<sub>VOW</sub>, which militate

against deletion and epenthesis, respectively. Crucially, these constraints must be ranked higher than IDENT-IO[Place].

Unlike V-epenthesis, C-deletion is visibly active in this language to avoid CODA COND violations (see §2.5.3). In the case where deletion is favoured over epenthesis, this implies that MAX-IO<sub>CONS</sub> must be ranked lower than DEP-IO<sub>VOW</sub>. To account for the case under discussion, I then establish the following part of the constraint ranking: ALIGN-STOP(K), DEP-IO<sub>VOW</sub> >> ALIGN-RIGHT >> MAX-IO<sub>CONS</sub> >> IDENT-IO[Place]. The tableau in (79) clarifies the arguments we just made. For convenience, the relevant stem-edge, the syllable boundary and delinking are marked by '|', '·' and '< >', respectively.

(79) Debuccalisation

/masak/	ALIGN- STOP(K)	DEP- IO <sub>VOW</sub>	ALIGN- RIGHT	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. ma.sak .	*!				
b. ma.sa.k ə.		*!	*		
c. ma.sa.< >			*	*!	
d.  ma.saʔ . <Plc>			*		*

As can be seen, although the losing candidate (79a) is well-aligned constituent-wise, it incurs a fatal violation of ALIGN-STOP(K). Candidate (79b) is ruled out, as it fatally violates DEP-IO<sub>VOW</sub>. Candidates (79c) and (79d) spare this violation, but both disobey ALIGN-RIGHT. Thus, they are in a tie position, and subject to evaluation by the next available constraints. MAX-IO<sub>CONS</sub> rules out (79c) and determines (79d) as the winning candidate. A violation of IDENT-IO[Place] becomes irrelevant, since the victor has already been pronounced.

### 2.5.2 ALIGN-OBST: Obstruent Devoicing

Malay has both voiced and unvoiced obstruents in its phonemic inventory. However, native phonology demonstrates that only voiceless obstruents are permitted syllable-finally. Loan phonology inhibits a phenomenon the so-called Obstruent Devoicing which changes the underlying voiced obstruents /b, d, g/ into voiceless counterparts<sup>27</sup> (cf. Yunus 1980; Teoh 1994).

(80)	/dʒauab/	[dʒawap]	'answer'
	/abdi/	[apdi]	'slave'
	/adab/	[adap]	'manners'
	/dekad/	[dekat]	'decade'
	/abad/	[abat]	'century'
	/dʒag/	[dʒaʔ]	'jug'
	/ragbi/	[raʔbi]	'rugby'

<sup>27</sup> It should be noted that all word final voiceless stops are unreleased, which means that the contact between the lips or other relevant articulatory organs for producing stop sounds, is not exploded or completely released.

The rule of Obstruent Devoicing is formulated in Teoh (1994:53) as in (81). Notice that the voice velar stop /g/ does not change into [k], as predicted by the rule, but becomes a glottal stop instead. This must be due to the effect of ALIGN-STOP (K) discussed earlier.

$$(81) \quad \left( \begin{array}{c} + \text{ cons} \\ - \text{ cont} \\ + \text{ voice} \end{array} \right) \rightarrow [- \text{ voice}] / \begin{array}{c} \text{---} \\ | \\ \text{C}_{\text{lo}} \end{array}$$

As we commented on earlier, rule (81) also lacks explanatory motivation. In our analysis, the Obstruent Devoicing in the coda is the effect of the CODA COND constraint which bars voiced obstruents in the coda. CODA COND is formalised in terms of Itô and Mester's (1994) alignment constraint as ALIGN-OBST (Align Obstruent), which requires that the voiced obstruent segments be left-aligned with a syllable.

$$(82) \quad \text{ALIGN-OBST} \\ \text{Align-Left (voiced obstruent, } \sigma \text{)}$$

Similarly to Debuccalisation (§2.5.1), one possibility of satisfying ALIGN-OBST is by feature delinking. In this particular case, the feature [voice] of the input is not faithfully parsed. This strategy is closely similar to Obstruent Neutralisation in German (cf. Lombardi 1995) and Coda Devoicing in Dutch (cf. Booij 1997). As mentioned, the price of the feature delinking mechanism is a violation of the featural markedness constraint IDENT-IO, particularly IDENT-IO[Voice], as in (83).

$$(83) \quad \text{IDENT-IO[Voice]} \\ \text{The correspondent of the input segment specified as [Voice] must be [Voice].}$$

Just like with ALIGN-STOP(K), other possibilities of feature changing strategies, such as stops becoming nasals (i.e. /b/ → [m]) or stops becoming fricatives (i.e. /b/ → [f]), are ruled out by the assumption that IDENT-IO[Sonorant] and IDENT-IO[Continuant] are ranked higher than ALIGN-OBST in the hierarchy.

The elimination of candidates with vowel epenthesis and consonant deletion at the stem edge are not the consequence of ALIGN-RIGHT, but are rather due to DEP-IO<sub>vow</sub> and MAX-IO<sub>cons</sub>. Similarly to Debuccalisation, the faithfulness constraints MAX-IO<sub>cons</sub> and DEP-IO<sub>vow</sub> must outrank the featural faithfulness constraint IDENT-IO[Voice]. The interaction of ALIGN-OBST, DEP-IO<sub>vow</sub> >> ALIGN-RIGHT >> MAX-IO<sub>cons</sub> >> IDENT-IO[Voice] is illustrated in the tableau below.

$$(84) \quad \text{Obstruent Devoicing}$$


/abad/	ALIGN-OBST	DEP-IO <sub>vow</sub>	ALIGN-RIGHT	MAX-IO <sub>cons</sub>	IDENT-IO[Voice]
a. a.bad .	*!				
b. a.ba.d ə.		*!	*		
c. a.ba.< >			*	*!	
d. a.bat .			*		*

Observe that in (80) the voiced velar /g/ surfaces as a glottal stop [ʔ], instead of the voiceless velar [k] predicted by Obstruent Devoicing. The g ~ ʔ alternation is not inexplicable


if we invoke the earlier CODA COND constraint of ALIGN-STOP(K) (73). If /g/ were to become [k], this would violate ALIGN-STOP(K), since [k] occurs in the syllable coda position. As demonstrated in (79), the optimal way of eschewing an ALIGN-STOP(K) violation is by delinking the feature [Place], the segment thus surfacing as a glottal stop.

Given the fact that IDENT-IO[Place] is lower ranked in the hierarchy, it is plausible for /b, d/ to become a glottal stop as well. However, this possibility can never be optimal because in addition to the IDENT-IO[Place] violation, it disobeys IDENT-IO[Voice] as well. In this situation, the two constraints do not conflict, and therefore they are not ranked with respect to each other. Putting all the constraints together yields the following set of rankings: ALIGN-OBST, ALIGN-STOP(K), DEP-IO<sub>vow</sub> >> ALIGN-RIGHT >> MAX-IO<sub>CONS</sub> >> IDENT-IO[Place], IDENT-IO[Voice].

(85) Alternation of g ~ ?

/d3ag/	ALIGN-OBST, ALIGN-STOP(K), DEP-IO <sub>vow</sub>	ALIGN- RIGHT	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]	IDENT- IO[Voice]
a. d3ag .	ALIGN-OBST *!				
b. d3a.g ə.	DEP-IO <sub>vow</sub> *!	*			
c. d3a.< > .		*	*!		
d. d3ak . <Voi>	ALIGN-STOP(K) *!	*			*
e.  d3aʔ . <Plc, Voi>		*		*	*

(86) Alternation of voiced ~ voiceless obstruents

/abad/	ALIGN-OBST, ALIGN-STOP(K), DEP-IO <sub>vow</sub>	ALIGN- RIGHT	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]	IDENT- IO[Voice]
a. a.bad .	ALIGN-OBST *!				
b. a.ba.d ə.	DEP-IO <sub>vow</sub> *!	*			
c. a.ba.< > .		*	*!		
d.  a.bat . <Voi>		*			*
e. a.baʔ . <Plc, Voi>		*		*!	*

As can be seen, the failed candidate (85d), which undergoes the regular Obstruent Devoicing strategy, is ruled out because it incurs a fatal violation of ALIGN-STOP(K). The optimal candidate (85e) spares ALIGN-STOP(K) and ALIGN-OBST at the expense of violating IDENT-IO[Place] and IDENT-IO[Voc] respectively. However, in the case of the voiced ~ voiceless obstruent alternation in (86), a candidate violating IDENT-IO[Place] and IDENT-IO[Voc] can never be optimal, because there is always a better candidate, (86d), which only violates the latter.



2.5.3 ALIGN-RHOTIC: *r*-Deletion

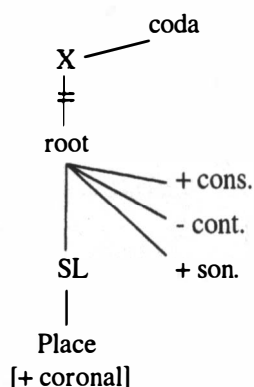
It has long been observed that the segment /r/ is never pronounced word finally in Malay (Yunus 1980; Asmah 1975; Farid 1980). As Yunus (1980:73) points out, 'Many speakers, perhaps the majority of speakers in Malaya and Singapore, do not use [r] in word final position; neither pronunciation will make any semantic change in the word: [bəna] or [bənar] "true or correct"'.<sup>28</sup>

In the previous rule-based analysis, the absence of [r] in stem final position is treated as an obligatory /r/ deletion rule by Farid (1980:16), but as an optional /r/ delinking rule by Teoh (1994:43).<sup>28</sup> As shown in (87) and (88), both rules have the same structural description, that is, /r/ in coda position. We will argue later that this rule is oversimplified. Based on our available data, it is attested that in a stem medial position the coda /r/ is always preserved and distinctively manifested in the surface forms (i.e. /tərbaŋ/ → [tərbaŋ] 'to fly' and not \*[təbaŋ]).

(87) /r/ deletion rule (Farid 1980:16)

$$r \rightarrow \emptyset / \text{ \_\_\_\_\_\_ } \{ \#, C \}$$

(88) /r/ delinking rule (Teoh 1994:43)



Before we offer an OT account of the phenomenon, there are some important remarks about the segment /r/ that need to be addressed. In literary Malay, this segment is represented as *r*, and described as an alveolar trill (Asmah 1977:2) or as a rolled alveolar consonant (Yunus 1980:73). However, both of these authors, agree that the literary *r* is commonly realised as a voiced velar fricative [ɣ], instead of a trill or a rolled [r] by most Malay speakers (Yunus 1980:95; Asmah 1975:70).

As noted in Asmah (1975:70), 'None of the Malay dialects in Malaysia as far as I know, pronounce *r* as an alveolar trill. The letter *r* in our writing system represents the dialectal [ɣ] and [R]. The velar fricative [ɣ] occurs in the southern dialect, while the uvular fricative [R]<sup>29</sup> occurs in the northern dialect'.

<sup>28</sup> Based on the previous observations of Asmah (1975), Yunus (1980) and Farid (1980), and prevalently supported by our contemporary data, I disagree with Teoh (1994) and strongly affirm that /r/ deletion word finally is absolutely obligatory.

<sup>29</sup> It must be mentioned that Asmah (1975) has employed an incorrect IPA symbol for representing the sound. A uvular fricative is commonly symbolised with [χ], while a letter [R] represents a uvular trill.



Farid (1980:16) claims that this sound is 'a non-trilled [r] ... which is produced with the tongue somewhat retracted towards the front of the soft palate, and without radical constriction, and is described in this work as a voiced back liquid'. This segment is represented as /r̥/ in Farid (1980).

Based on our available data, we absolutely agree with Yunus (1980) and Asmah (1975) that the literary *r* segment is commonly pronounced as a voiced velar fricative /ɣ/. In terms of manner of articulation, /ɣ/ is undeniably a fricative sound at the phonetic level of representation. However, at the phonological level, it must be represented as a liquid segment because it exhibits similar behaviour to the lateral /l/.<sup>30</sup> This is not a peculiar case, as Lass (1984:157) asserts,

'Liquids' covers a disparate set of segments, primarily lateral approximants and 'r', i.e. alveolar and post-alveolar trills, taps, and approximants, and occasionally fricatives, and some uvular and velar trills, fricatives and approximants. (Whether a fricative 'counts as' an obstruent or a liquid is a matter of phonological analysis: German /ʁ/ counts as a liquid with /l/ because of its distribution and other phonological behaviour).

Another significant observation about this segment is that its occurrence at the stem-suffix boundary, particularly when it is followed by the vowel initial suffixes /-an/ and /-i/, most often surfaces as a flap [r] instead of [ɣ], more specifically as a geminate [rr].<sup>31</sup> The flap [r] is produced by a single rapid contact between the tip of the tongue and the alveolar ridge. For some speakers, however, both variants are used interchangeably without any difference of meaning.<sup>32</sup> We therefore regard this allophonic alternation as free variation. However, for convenience of presentation, we represent this segment as a trill [r], similarly to the form used in literary Malay. To begin our analysis of r-Deletion phenomenon, we lay out some relevant examples as in (89).

(89) a. Word final /r/

/kotor/	[koto:]	'dirty'
/uker/	[uke:]	'to carve'
/ukor/	[uko:]	'to measure'
/pasar/	[pasa:]	'market'

b. Root final /r/ + V-initial suffix

/kotor+an/	[kotorran]	'dirt'
/uker+an/	[ukerran]	'carving'
/ukor+an/	[ukorran]	'measurement'
/pasar+an/	[pasarran]	'market'

<sup>30</sup> In the process of affixation with the nasal-final prefixes /məŋ-/ and /pəŋ-/, stems begin with /l/ and /ɣ/ segments generally undergo the same phonological rule called Nasal Deletion. See Chapter 4 for detailed discussion.

<sup>31</sup> All C-final stems surface as geminates at the stem-suffix juncture, and this phenomenon will be discussed in length in Chapter 3.

<sup>32</sup> This allophonic variation is also observed by Yunus (1980:95) and he states, '[r] in final position of a base word will be rendered [ɣ] in the speech of some speakers when followed by the suffixes [-an] or [-i], in which case the [r] or [ɣ] will now be the initial consonant of the final syllable in the newly formed complex word'.

## c. Root internal /r/

/pərlu/	[pərlu]	*[pəlu]	'must'
/tərbaj/	[tərbaj]	*[təbaŋ]	'to fly'
/tərdʒon/	[tərdʒon]	*[tədʒon]	'to dive'
/kərdʒa/	[kərdʒə]	*[kədʒə]	'work'

## d. /r/ final prefix + V-initial stems

/bər+ubah/	[bərubah]	'change'
/bər+ikot/	[bərikot]	'as follows'
/tər+aŋkat/	[təraŋkat]	'carry'

## e. /r/ final prefix + C-initial stems

/bər+kərdʒa/	[bəkərdʒə]	'work'
/bər+lawan/	[bəlawan]	'fight'
/tər+sepak/	[təsepaʔ]	'kick'

Notice that in (89a) when the segment /r/ is deleted, the preceding vowels will then get lengthened. This particular case of compensatory lengthening is quite common in many Malay dialects (cf. Collins 1986; Zaharani 1991). This is captured in Teoh (1994) as a process of relinking the timing X-slot to the preceding vowel. As Teoh (1994:47) points out, 'r/ deletion is seen as a delinking of the root node, thus erasing everything that it dominates leaving behind an empty X-slot. The preceding vowel then relinks to the empty X-slot thus resulting in the lengthening of the vowel'. It is important to note that the deletion of the prefix-/r/ in (89e) is never accompanied by compensatory lengthening either in the standard dialect (cf. Farid 1980) or in the regional dialects (Zaharani 1991). The prohibition of compensatory lengthening at the prefix juncture will be accounted for in chapter four.

Observe that in (89c), the underlying /r/ is always preserved root internally. This fact is not captured in the previous rule-based approaches. Given the formalisations in (87) and (88), r-Deletion will certainly apply, since its structural description is fully satisfied. This derivation, however, yields an incorrect surface form, as indicated by the asterisk in (89c). Thus, the previous accounts of r-Deletion in Malay are descriptively and explanatorily inadequate.

The deletion and preservation of /r/ in the coda can be accounted for quite elegantly in our analysis. As usual the choice is based on the interaction of constraints in the constraint hierarchy. The candidate that best satisfies the constraint ranking will always emerge as the optimal form.

Obviously, the deletion of /r/ in the coda must be triggered by the CODA COND constraint. And again, by adopting Itô and Mester's (1994) alignment formalism, the relevant constraint at play here is ALIGN-RHOTIC, which requires that the segment /r/ be left-aligned with a syllable.


## (90) ALIGN-RHOTIC

Align-Left (r, σ)

As shown in (89), the optimal way of satisfying the CODA COND constraint in (90) is by segmental deletion. This strategy is similar to that of the Eastern Massachusetts dialect as reported in McCarthy (1993a). Deleting the final segment of a stem incurs a violation of ALIGN-RIGHT. Crucially, for the case under discussion the hierarchical ranking is ALIGN-RHOTIC >> ALIGN-RIGHT, as demonstrated in tableau (91). Since a feature changing

mechanism is not harmonic here, therefore any possible IDENT-IO[F] constraint must be ranked higher than ALIGN-RHOTIC in the hierarchy.


(91) r-Deletion: ALIGN-RHOTIC >> ALIGN-RIGHT

/kotor/	ALIGN-RHOTIC	ALIGN-RIGHT
a. ko.tor	*!	
b.  ko.to:.< >		*

Another possibility for eschewing the ALIGN-RHOTIC violation is by V-epenthesis (i.e. [ko.to.rə]). This candidate violates ALIGN-RIGHT as well, since the syllable edge and stem edge do not coincide. Thus, we have a tie situation here which must obviously be resolved by the faithfulness constraints. Deleting an input consonant violates MAX-IO<sub>CONS</sub>, and inserting epenthetic vowel violates DEP-IO<sub>VOW</sub>. In the case where deletion is favoured over epenthesis, MAX-IO<sub>CONS</sub> must be ranked lower than DEP-IO<sub>VOW</sub>.

Considering the case under discussion, the relevant ranking to account for the phenomenon of r-Deletion is as follows: DEP-IO<sub>VOW</sub>, ALIGN-RHOTIC, >> ALIGN-RIGHT >> MAX-IO<sub>CONS</sub>.

(92) r-Deletion

/kotor/	DEP-IO <sub>VOW</sub>	ALIGN-RHOTIC	ALIGN-RIGHT	MAX-IO <sub>CONS</sub>
a. ko.tor		*!		
b. ko.to.r ə.	*!		*	
c.  ko.to:.< >			*	*

Another important observation in the data in (89) that has not been explored thus far is the phenomenon of compensatory lengthening. As mentioned, when the coda /r/ is deleted, the preceding vowel then gets lengthened. It is common crosslinguistically that a deletion of a coda consonant is always followed by vowel lengthening, such as in Latin (Ingria 1980, Bichakjian 1986), Ancient Greek (Wetzels 1986), Turkish (Sezer 1986) and Tiberian Hebrew (Lowenstamm & Kaye 1986).

Following the same interpretation of the autosegmental analysis, compensatory lengthening is construed in this study as the result of parsing the timing X-slot (possibly analysed as a mora) to the preceding vowel. Thus, we need another formal constraint that belongs to the MAX-IO constraint family called MAX-IO<sub>X</sub>, which is formally defined as in (93).

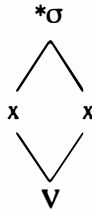
(93) MAX-IO<sub>X</sub>

Every X in the input must have a correspondent in the output.

Although MAX-IO<sub>CONS</sub> and MAX-IO<sub>X</sub> belong to the same MAX-IO family, they are two distinct constraints, and therefore in principle they are separately rankable in the hierarchy. Given the facts of Malay, these two constraints never conflict, and therefore they don't need to be ranked with respect to each other.

When the timing X-slot is associated to the preceding vowel, this creates a long vowel with a doubly-linked structure. The price for this is a violation of a constraint in (94), which prohibits long vowels (cf. Rosenthal 1994).

(94) No Long Vowel (NLV)



Crucially, the faithfulness constraint MAX-IO<sub>x</sub> must outrank NLV in the hierarchy. Putting all the constraints together, the relevant ranking for r-Deletion is now established as follows: DEP-IO<sub>vow</sub>, ALIGN-RHOTIC, >> ALIGN-RIGHT >> MAX-IO<sub>CONS</sub>, MAX-IO<sub>x</sub> >> NLV.

(95) r-Deletion and compensatory lengthening

/kotor/	DEP- IO <sub>vow</sub>	ALIGN- RHOTIC	ALIGN- RIGHT	MAX- IO <sub>x</sub>	MAX- IO <sub>CONS</sub>	NLV
a. ko.tor .		*!				
b. ko.to.r ə.	*!		*			
c. ko.to.< >			*	*!	*	
d. ☞ ko.to:.< >			*		*	*

In addition to segmental deletion, the failed candidate (95c) erases the timing-X unit as well, thus, incurring MAX-IO<sub>CONS</sub> and MAX-IO<sub>x</sub> violations. The optimal candidate (95d) satisfies MAX-IO<sub>x</sub> by parsing the underlying X-element to the preceding vowel, which surfaces as a long vocoid. The satisfaction of MAX-IO<sub>x</sub> compels a violation of NLV. This violation is irrelevant, since the victor has already been determined.

The next important generalisation that needs to be accounted for is the preservation of /r/ in root internal position, as in (89c). As mentioned, this fact has been overlooked in previous studies. Given the constraint ranking established in (95), a candidate with /r/ deletion will always emerge as the winner, as the following tableau illustrates.


(96). r-Deletion root internally: incorrect result

/tərbəŋ/	DEP- IO <sub>vow</sub>	ALIGN- RHOTIC	ALIGN- RIGHT	MAX- IO <sub>x</sub>	MAX- IO <sub>CONS</sub>	NLV
a. ☺ tə.r.bəŋ		*!				
b. tə.rə.bəŋ	*!					
c. tə.bəŋ				*!	*	
d. ☞ *tə:.bəŋ					*	*

As can be seen, the optimal form falls to candidate (96d). However, this is not the correct surface form in the language. This suggests that the deletion of /r/ root internally should be avoided because it crucially effects some other dominant constraints in the grammar.

Recall the case of hiatus preservation in §2.3. ONSET is minimally disobeyed in order to satisfy CONTIGUITY (63), in particular ROOTCONTIG, which disallows any process of deletion or epenthesis within the root morpheme. The same phonological effect equally applies in the case of r-Deletion. As established earlier, ROOTCONTIG is an unviolated constraint, therefore it is undominated in the hierarchy. The tableau below gives a better picture of how a candidate with a coda /r/ surfaces as an optimal form.

(97) Preservation of /r/ root internally

/tərbaŋ/	ROOT CONTIG	DEP- IO <sub>vow</sub>	ALIGN- RHOTIC	ALIGN- RIGHT	MAX- IO <sub>x</sub>	MAX- IO <sub>cons</sub>	NLV
a.  tər.baŋ			*				
b. tər.ɾə.baŋ	*!	*					
c. tə.baŋ	*!				*	*	
d. tə:.baŋ	*!					*	*

In short, although the CODA COND constraint ALIGN-RHOTIC is a highly ranked constraint, it can be violated root internally in order to obey the more dominant constraint in the hierarchy ROOTCONTIG. ROOTCONTIG captures the generalisation about the irregular behaviour of the root stems with respect to rules that are visibly active in the language.

#### 2.5.4 ALIGN-NASAL: Nasal Assimilation

Another phonological effect of CODA COND is on nasal segments. All the previous studies affirmed that a nasal segment which forms the coda of the first syllable is always homorganic with the following onset obstruent, and this fact is captured by a very general rule called Nasal Assimilation (Farid 1980:13; Teoh 1994:101). This generalisation is true for clusters within the stem and at the prefix juncture, but not for clusters at the suffix boundary, as the following examples show.

(98) a. Homorganic cluster within the stem

/sampan/	[sampan]	'boat'
/nampak/	[nāmpaʔ]	'to see'
/pantas/	[pantas]	'fast'
/pandu/	[pandu]	'to drive'
/paŋdʒat/	[paŋdʒat]	'to climb'

b. Homorganic cluster at prefix juncture

/məŋ+basoh/	[māmbasoh]	'wash'
/məŋ+datan/	[māndatan]	'come'
/məŋ+gali/	[māŋgali]	'dig'
/məŋ+dʒilat/	[māŋdʒilat]	'lick'

c. Non-homorganic cluster at suffix boundary

/tanam+kan/	[tanāmkən]	*[tanāŋkən]	'bury (imperative)'
/hitam+kan/	[hitamkən]	*[hitaŋkən]	'blacken (imperative)'
/padan+kan/	[padankən]	*[padaŋkən]	'match (imperative)'
/təkan+kan/	[təkankən]	*[təkaŋkən]	'press (imperative)'

## d. Word final nasal

/malam/	[mālam]	'night'
/makan/	[mākan]	'to eat'
/pasar/	[pasar]	'to assemble'

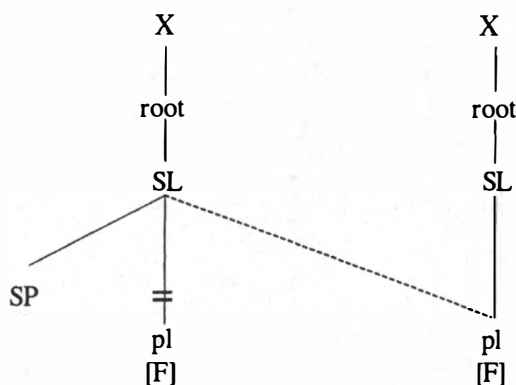
The occurrence of homorganic clusters is common cross-linguistically and is construed as the result of Nasal Assimilation. In Farid's (1980) analysis, Nasal Assimilation is formalised as a feature changing rule as in (99). One notable comment about the formalism in rule (99) is that it is very unconstrained and cumbersome.

## (99) Nasal Assimilation as feature changing (Farid 1980:13)

$$[+nasal] \rightarrow \begin{bmatrix} \alpha \text{ ant} \\ \beta \text{ cor} \\ . \\ . \end{bmatrix} / \text{ — } \begin{bmatrix} C \\ \alpha \text{ ant} \\ \beta \text{ cor} \\ . \end{bmatrix}$$

Within the multilinear framework (Teoh 1994), Nasal Assimilation is interpreted as a process of spreading, that is, the nasal segment gets its specification for place of articulation through linking with the following consonantal segments. This is illustrated in (100).

## (100) Nasal Assimilation as Spreading (Teoh 1994:101)



Notice that in (98c) Nasal Assimilation fails to apply, otherwise we will get incorrect surface forms, as indicated by the asterisk. However, given the formulations of the rules in (99) and (100), we would expect nasal assimilation to take place, because its environment is fully satisfied.

This irregular behaviour of Nasal Assimilation at the suffix boundary is not discussed in Teoh (1994). Farid (1980:13), on the other hand, regards this as an exception, as he notes, 'Nasals always appear on the surface as homorganic to a following consonant, except in cases of reduplication, or if the cluster consists of nasal plus suffix-initial consonant [kan]'.

In an OT account, the irregularity of Nasal Assimilation at the suffix juncture is explainable. This process does not take place in the optimal output because the candidate in hand is not the candidate best satisfying the constraint hierarchy.

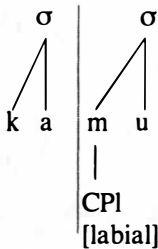
As is widely accepted, Nasal Assimilation in natural languages is triggered by the CODA COND constraint. As mentioned, in the earlier OT analysis (McCarthy & Prince 1993ab, 1994), the CODA COND for nasals is defined in prose as in (66) above. Following Itô and Mester (1994), this constraint has been reinterpreted and reformalised in terms of alignment statement, and we label it ALIGN-NASAL here.

(101) ALIGN-NASAL

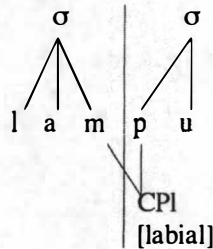
Align-Left (CPlace Nasal,  $\sigma$ )

The constraint in (101) penalises any occurrence of specified CPlace nasal in the coda. As established in the earlier version of CODA COND (Itô 1986), geminates and place-linked clusters are not counted as a violation. Itô and Mester (1994:34) call this noncrisp alignment, as opposed to the crisp one. The difference between crisp and noncrisp alignments can be seen below.

(102) a. [kamu] 'you'



b. [lampu] 'light'




The CPlace in (102a) fulfils ALIGN-NASAL, since it is exclusively linked as a leftmost syllable daughter ('Crisp alignment'). The CPlace in (102b) satisfies ALIGN-NASAL as well, because it is linked to the left edge of the second syllable, in spite of the additional link to the preceding syllable ('noncrisp alignment') (cf. Itô & Mester 1994).

In the rule-based approach, the process of Nasal Assimilation basically involves two general procedures. First, the nasal segment loses its specified [Place] node by delinking. Second, it obtains a new [Place] node from the following consonant through spreading. The consequence of Nasal Assimilation is a violation of the featural faithfulness constraint IDENT-IO[Place] (74), which requires that the correspondent of the input segment specified as [Place] must be [Place]. A violation of IDENT-IO[Place] directly effects ALIGN-RIGHT. As mentioned, in order for ALIGN-RIGHT to be fully satisfied, all the feature content of the input stem, as well as the root node, must have a correspondent in the output (cf. McCarthy 1993b; Lombardi 1995).

Obviously, the inapplicability of Nasal Assimilation at the suffix boundary is the consequence of satisfying ALIGN-RIGHT. Thus, the ranking is ALIGN-RIGHT >> ALIGN-NASAL. As mentioned, although ALIGN-STOP(K) and ALIGN-NASAL belong to the same CODA COND family, they are distinct constraints, and therefore they can be separately ranked in the constraint hierarchy. Tableau (103) gives a clear illustration why an assimilated candidate fails to emerge as the winner. Since ALIGN-OBST is irrelevant here, it is not represented in the tableau.




## (103) ALIGN-NASAL violation at the suffix juncture

/tanam+kan/	DEP- IO <sub>vow</sub>	ALIGN- RIGHT	ALIGN- NASAL	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. ta.na.< > kan		*!		*	
b. ta.na.m ə.kan	*!	*			
c. ta.naŋ .kan <Plc>		*!			*
d.  ta.nam .kan			*		

The assimilated candidate (103c), which has a multiple-linked structure survives ALIGN-NASAL, in compliance with a noncrisp alignment. The delinking of the [Place] node of the underlying nasal /m/, however, fatally violates ALIGN-RIGHT. The optimal candidate (103d) is featurally faithful to the input, but it disobeys the dominated CODA COND constraint ALIGN-NASAL.

The hierarchical ranking in (103) also accounts for the preservation of the specified feature [Place] of the nasal segment word finally. This is illustrated in tableau (104).

## (104) ALIGN-NASAL violation word finally

/tanam/	DEP- IO <sub>vow</sub>	ALIGN- RIGHT	ALIGN- NASAL	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. ta.na.< >		*!		*	
b. ta.na.m ə.	*!	*			
c. ta.nā . <Plc>		*!			*
d.  ta.nam .			*		

Observe that candidate (104c) undergoes Debuccalisation not C-Deletion. As noted, Debuccalisation is a process that involves delinking of the Place node. As illustrated in (75), /k/ debuccalises into a glottal stop in order to avoid a violation of the CODA COND constraint ALIGN-STOP(K). In this particular case, when the nasal segments lose their [Place] node of articulation, leaving behind a nasal element [nasal] (i.e. a nasal lacking a point of articulation). This nasal element is then docked into the preceding vowel deriving a nasalised vowel.

Nasal Debuccalisation is a very productive rule in some of the Malay dialects as a strategy used to get rid of word-final nasals (cf. Teoh 1994; Trigo 1991). The effect of Debuccalisation is a violation of ALIGN-RIGHT as well as the featural faithfulness constraint IDENT-IO[Place]. The Debuccalised candidate (104c) cannot be better than the optimal candidate (104d), which preserves the specified [Place] node of the nasal segment.


On the other hand, at the prefix juncture, the nasal segment in the coda of the first syllable is always homorganic with the following onset obstruent of the second syllable. The application of Nasal Assimilation suggests that ALIGN-NASAL must be obeyed by the candidate in order to emerge as the optimal output.

In previous studies the C-final prefix in (98b) is represented with nasal segment which is not specified for the feature node [Place] (cf. Teoh 1994, Kroeger 1988). This consonant gets its [Place] node from the following obstruent through spreading. It has been argued that

underspecification is unnecessary in the analysis of OT (Prince & Smolensky 1993; Itô, Mester & Padgett 1995). As Itô, Mester and Padgett (1995) point out, 'Since there is no sequential phonological derivation in Optimality Theory, there is no sense in which (parts of) the phonological derivation could be characterised by underspecification'. Following this assumption, I construe the nasal-final prefix in Malay as fully specified in the lexical representation, and as represented as a dorsal nasal /ŋ/, since this segment appears before V-initial stems (cf. Farid 1980).

Nasal Assimilation applies at the prefix boundary, and this suggests that a process of delinking is taking place here. However, this has no effect on ALIGN-RIGHT, since the effected segment occurs at the left edge of the stem. In this case, ALIGN-RIGHT is vacuously satisfied by an assimilated candidate. By employing the same ranking hierarchy in (104), the effect of Nasal Assimilation at the prefix boundary is demonstrated in tableau (105) below.

(105) ALIGN-NASAL satisfaction at the prefix juncture

/məŋ+basoh/	DEP- IO <sub>VOW</sub>	ALIGN- RIGHT	ALIGN- NASAL	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. məŋbasoh			*!		
b. məŋəbasoh	*!				
c. məbasoh				*!	
d.  məmbasoh <Plc>					*

The alignment constraint ALIGN-RIGHT is irrelevant in this prefixal environment, and therefore it is vacuously satisfied by all the candidates. Candidate (105a) gets its [Place] node by default and surfaces as a velar nasal [ŋ]). The cluster is not homorganic, and therefore it is ruled out by ALIGN-NASAL. The failed candidates (105b) and (105c) spare ALIGN-NASAL at the expense of violating the faithfulness constraints DEP-IO<sub>VOW</sub> and MAX-IO<sub>CONS</sub>, respectively. Candidate (105d) incurs no such violation and is the victor.

## 2.6 Mid-vowels in closed final syllables

It has been proposed that Malay has a rule, the so-called Vowel Lowering rule, which changes the high vowels /i/ and /u/ to the mid-vowels [e] and [o] in a closed final syllable. This rule is formalised in Farid (1980) and Teoh (1993) as in (106a) and (106b) below.

(106) a. Vowel Lowering (Farid 1980:20)

V  
[+ high] → [- high] / \_\_\_\_ C {C, # }

b. Vowel Lowering Rule (Teoh 1994:32)

V      → [- high] / \_\_\_\_  
[+ high]      |  
                 VC]<sub>stem</sub>

As can be seen, although the rule predicts the same phonological alternation, its domain of application is totally different. Rule (106a) applies within the word domain, whereas rule (106b) operates within the stem domain. Besides this substantial difference, the evidence in Farid (1980) and Teoh (1994) to justify the necessity of this rule is also significantly distinct.

We shall argue later that there is no strong phonological evidence or motivation for postulating the so-called Vowel Lowering rule, and therefore it should be discarded from the Malay grammar. Without this rule, the mid vowels /e/ and /o/ are represented as underlying. One of the advantages of this representation is that no additional rule is needed, making the grammar simpler and more easily learned.

The phonology of the native vocabulary shows that there is a general pattern regulating the distribution of high and mid-vowels in the final syllable of the stems. The high vowels [i, u] occur in open syllables, while the mid-vowel [e, o] occur in closed syllables, except in cases where the final /r/ gets deleted in the surface outputs, as in [uko:], [uke:], which are derived from /ukor/ 'to measure' and /uker/ 'to carve' respectively (cf. Yunus 1980; Teoh 1994). In addition, there is also a general restriction restraining the occurrence of vowels in the preceding syllable. In particular, the high vowels [i, u] in open final syllables never cooccur with the mid vowels [e, o], except in a few borrowed words, such as [topi] 'hat', [lori] 'lorry', and [dzeli] 'jelly'.

In his taxonomic analysis, Yunus (1980) captures this generalisation as complementary distribution and vowel harmony. As observed, the high vowels [i, u] and the mid-vowels [e, o] are distributionally complementary stem-finally. Thus, Yunus (1980:25) noted that 'therefore in a phonemic analysis of these vowel sounds, members of each group may, with due regard to certain exceptions, be considered as allophones of the same phoneme'. Furthermore, in determining the phonemic representation of the stem-final syllable, he introduces the notion of vowel harmony.

Yunus (1980:21) defines vowel harmony as 'the regular "adjustment" in the manner of production and in the point of articulation of the first vowel in disyllabic simple words of the structures VCV, VCCV, CVCV, CVCCV (all with open final syllable) and VCVC, VCCVC, CVCVC, and CVCCVC (all with closed final syllable), to "harmonise", as it were, with the second vowel in the respective structures. In other words, the manner and point of articulation of one vowel are conditioned by the other vowel in the same structure'.

In compliance with the idea of vowel harmony defined above, vowels in the closed final syllable will be represented as mid-vowels /e, o/, if the first vowels are also mid-vowels /e, o/ (107a), and conversely as high vowels /i, u/, if the first vowels are /i, u, a, ə/ (107b). This principle is implemented in the new spelling system of Malay (1975).<sup>33</sup> Some relevant examples are as follows:

(107) a.	/gelen/	[gelen]	'to shake (head)'
	/tempoh/	[tempoh]	'duration'
	/golon/	[golon]	'to group'
	/boleh/	[boleh]	'able'

<sup>33</sup> It must be noted that in the old spelling system (Ejaan Sekolah), the high vowels, /i/ and /u/ in final closed syllables were spelled as <e> and <o> respectively. However, under the new spelling system 1975 (Pedoman Umum Bahasa Malaysia), these vowels are spelled as <i> and <u> if the vowels in the preceding syllable are <i>, <u>, <a>, and <ə>, but are spelled as <e> and <o> if the vowels in the preceding syllable are <e> and <o>.

b. /giliŋ/	[gileŋ]	'to grind'
/tulis/	[tules]	'to write'
/guluŋ/	[guloŋ]	'to roll'
/siput/	[sipot]	'snail'
/sakit/	[saket]	'sick'
/takut/	[takot]	'scared'
/təmpuh/	[təmpoh]	'to face'

Arguably, this phonemic analysis of Yunus (1980) is the source of Farid's (1980) and Teoh's (1994) analyses. However, they offer different phonological evidence, as we shall examine shortly, arguably because the principle of vowel harmony introduced in Yunus (1980) is incorrect and misleading.

Let us first consider the evidence offered in Farid (1980). According to Farid (1980:20), 'Underlying high vowels, /i/ and /u/, normally correspond to their surface realisations, [i] and [u], respectively, but they become [e] and [o] when in final closed syllable, or when a cluster of consonants follows'. The following examples cited in Farid (1980:20) demonstrate this generalisation.

(108) /milik/	[mileʔ]	'to own, to possess'
/milik-i/	[miliki] ~ [mileʔki]	'to cause to own'
/pilih/	[pileh]	'to choose'
/pilih+an/	[pilihan]	'choice'
/pilih+kan/	[pilehkan]	'to cause to choose for'
/tutup/	[tutop]	'to close'
/məŋ+tutup+i/	[mənutupi]	'to cause to close'
/tutup+kan/	[tutopkan]	'to cause to close for'

The above facts are then accounted for by a rule, the so-called Vowel Lowering, which is formulated as in (106a). This rule is descriptively inadequate, particularly with respect to the environment CC (i.e. /pilih+kan/ → [pilehkan]). There are many cases where this rule never applies, specifically in stem medial positions, even though the environment CC is fully met. For instance, forms like /musnah/ 'to destroy', /dusta/ 'to lie', /cipta/ 'to create' are realised as [musnah], [dustə], and [ciptə], respectively, and not \*[mosnah], \*[dostə] and \*[ceptə].

In the case where vowel harmony is claimed in Yunus (1980), with both the first and the second syllables represented with the mid-vowels /e, o/, the relevant forms do not undergo any phonological alternation, as illustrated in the following examples cited from Farid (1980:21).

(109) /bele/	[beleʔ]	'to scrutinise'
/məŋ+bele+i/	[məmbeleʔki]	'to cause to scrutinise'
/mogok/	[mogoʔ]	'to strike'
/pəŋ+mogok+an/	[pəmogokʔkan]	'the strike'

In short, Farid (1980) captures the generalisation derived by vowel harmony in Yunus (1980) on the basis of evidence from phonological alternation. Teoh (1994b) disputes this fact and comments that the analysis offered in Farid (1980) is observationally inadequate. As observed in Teoh (1994:33), there is no [i, u] ~ [e, o] alternation between the bare and the suffixed forms, as shown in the following examples.

(110)	/pilih/	[pileh]	'to choose'
	/pilih+an/	[pilehhan] <sup>34</sup>	'choice'
	/pilih+kan/	[pilehkan]	'choose (imp)'
	/pukul/	[pukol]	'to hit'
	/pukul+an/	[pukollan]	'hitting'
	/pukul+kan	[pukolkan]	'hit (imp)'

To capture the generalisation in (110), Teoh (1994:34) formalises the rule of Vowel Lowering as in (106b), where its domain of application is the stem. Unlike Farid (1980), the evidence offered by Teoh (1994) for positing high vowels as underlying is based on phonological distribution. Teoh (1994:32) notes that there is complementary distribution between the high and mid-vowels in the final syllable of disyllabic stems. The high vowels occur in final open syllables, whereas the mid-vowels occur in final closed ones.<sup>35</sup> Based on universal tendency in vowel inventories, the high vowels /i, u/ are then chosen as the underlying forms because they are more basic and natural than /e, o/. It is argued that in many languages with a three vowel system, they invariably have high vowels in their inventories, rather than mid vowels.

Basically, complementary distribution is a device used to reduce the underlying inventory of phonemes. In the Malay case, both the high and the mid-vowels have already been established as phonemes, since they are contrastive in other environments. Thus, the argument that the high vowels /i, u/ make better phonemes than the mid-vowels /e, o/ does not arise at all.

Another piece of evidence offered in Teoh (1994) is based on the distribution of two-vowel sequences within a stem. According to Teoh (1994:25), there are only six sequences that are permissible within a stem, namely /iu/, /ia/, /ui/, /ua/, /ai/, and /au/. These underlying vowel sequences are built from combinations of the more primitive vowels /i, u, a/. The mid vowels /e, o, ə/ systematically fail to cluster with another vowel. Following this observation, forms such as [tiyop] 'to blow' and [duwet] 'money' are represented underlyingly as /tiup/ and /duit/, rather than /tiop/ and /duet/ respectively.

In addition, combinations of the same vowels such as \*/aa/, \*/ii/, and \*/uu/ within a stem are never permitted, and they are ruled out by the Obligatory Contour Principle (OCP), which prohibits the repetition of adjacent elements on a given autosegmental tier (Teoh 1994:26). By assuming that the closed final vowel is underlyingly high (i.e. \*/CiiC/ or \*/CuuC/, the systematic absence of \*/CiyeC and \*/CuwoC stems in the language can be explained as due to the OCP. As Teoh (1994:33) points out, 'If we assume that the intervocalic glides in \*/CiyeC and \*/CuwoC derive from spreading from the preceding high vowels, then we can exclude these forms by the OCP if the final syllable vowels are underlyingly high vowels'.

Contrary to Farid (1980), Teoh (1994) postulates the high vowels as the basic forms based on the criterion of vowel distributional restriction within a stem. It is apparent that Teoh's observation is oversimplified. First, his claim that mid vowels fail to cluster with another vowel is not true. One remarkable example is the presence of a diphthong /oi/ within a stem (Yunus 1980:41–43; Farid 1980).

<sup>34</sup> It is argued in Teoh (1994) that an addition of the suffix /-an/ triggers gemination of the preceding consonant. I shall discuss this in more detail in Chapter 3.

<sup>35</sup> For detailed discussion on vowel co-occurrence and distribution, see Teoh (1994:16–23).

(111)	/kaloi/	[kaloj]	'a fish name'
	/səpoi/	[səpoj]	'blowing softly'
	/səkoi/	[səkoj]	'millet'
	/dodoi/	[dodoj]	'lullaby'

The occurrence of underlying /oi/ contradicts Teoh's claim, and hence this sequence is deliberately disregarded in his analysis. As noted in Teoh (1994:23), 'The diphthong [oi] only occurs in stem final position in a handful of words and will be ignored in developing our analysis'.

Second, if we invoke our earlier assumption that the so-called glides are derived from the underlying high vowels, then there are many more instances of vowel combinations with the mid vowels, particularly in three-vowel sequences within a stem.

(112)	/leuat/	[lewət]	'late'
	/seua/	[sewə]	'rent'
	/seuel/	[sewel]	'mad'
	/goiaŋ/	[gojaŋ]	'to shake'
	/loia/	[lojə]	'to feel like vomiting'
	/toiol/	[tojol]	'ghost'

As shown in (111) and (112), it is permissible for the the mid-vowels /e, o/ to cluster with /i, u, a/ within a stem. Accordingly, it is plausible to posit /tiop/ and /duet/ as the underlying forms of [tijop] and [duwet], respectively, due to the fact that underlyingly /io/ and /ue/ do constitute licit clusters in Malay.

It is important to note that, despite the fact that he is arguing for the high vowel as the basic phoneme, many forms in Teoh (1994) are represented with the underlying mid-vowels as well. Some of the examples are /tembok/ 'wall', /gosok/ 'to rub', /cocok/ 'to pierce', /pendek/ 'short', /solek/ 'to make up' and /boleh/ 'able'. A generalisation that can be reached here is that both the first and the second syllables of the stems are composed of mid-vowels. These representations are similar to those in (107a), which is claimed to be derived by vowel harmony (Yunus 1980).

To sum up, in Farid (1980) and Teoh (1994), the occurrence of mid-vowels [e, o] in closed final syllables in Malay is analysed as the surface manifestation of two different underlying phonemes, namely the high vowels /i, u/ and the mid-vowels /e, o/. The high vowels then get lowered in the derivation by the so-called Vowel Lowering rule. As I argued, this rule is not phonologically motivated, and therefore I postulate the mid-vowels /e, o/ as underlying. One of the advantages of this representation is that no additional rule is needed, hence making the grammar simpler and more easily learned.

## 2.7 Conclusion

Malay is a (C)V(C) language which generally requires that every syllable must have a single onset in surface representation. This requirement prompts the parsing of pre-, post- and intervocalic high vowels in the syllable margins. Despite the fact that the satisfaction of ONSET is highly required, it can be minimally violated word initially and root internally in order to respect the more dominant constraints in the hierarchy, namely, ALIGN-LEFT and ROOTCONTIG.

Malay syllables may have a single member coda. However, a small class of segments is prevented from occupying the coda position, and this is governed by the CODA COND constraint family. Among the strategies used to eschew CODA COND violations are feature delinking, feature spreading and delinking of the root node.

For convenience of reference, I briefly tabulate some of the significantly motivated rankings that outline the general pattern of the Malay phonology.

(113) Constraint Rankings

Rankings	Effects
ONSET >> DEP-IO <sub>CONS</sub>	C-epenthesis to provide onset (15)
MAX-IO <sub>VOW</sub> >> DEP-IO <sub>CONS</sub>	C-epenthesis is preferred to V-deletion (16)
ONSET >> *M/H	Hiatus avoidance by parsing the high vowels in the margin (23) (24), (35), (37)
ONSET >> INTEGRITY-X	Hiatus avoidance by ambiskeletal parsing (31)
DEP-IO <sub>CONS</sub> >> INTEGRITY-X, *M/H	Tautosyllabic and ambiskeletal parsing are preferred to C-epenthesis (23), (33)
ALIGN-LEFT >> ONSET	Epenthesis is not allowed word initially (54) Onsetless syllables are freely tolerated
ROOTCONTIG >> ONSET	Epenthesis and deletion root internally is prohibited (64) Onsetless syllables are allowed root internally
ALIGN-STOP(K) >> IDENT-IO[Place]	Coda wellformedness by feature delinking (75)
ALIGN-OBST >> IDENT-IO[Voice]	Coda wellformedness by feature delinking (84)
ALIGN-RHOTIC >> MAX-IO <sub>CONS</sub>	Coda wellformedness by delinking of the root node (92)
ROOTCONTIG >> ALIGN-RHOTIC	Root internal epenthesis and deletion not sacrificed to get coda wellformedness (97)
ALIGN-RIGHT >> ALIGN-NASAL	Feature delinking not sacrificed to get coda wellformedness (103), (104)



# 3

## *The phonology-morphology interface in suffixation*

---

### 3.1 Introduction

This chapter investigates the phonological alternations that are derived due to the morphological process of suffixation. Generally, the phonology of suffixation reveals that the visibly active processes in the language are inapplicable in this particular domain, as if there was a barrier at the stem-suffix juncture blocking the application of the regular processes.

In this study, this apparent irregularity is accounted for as a consequence of a candidate output respecting a more dominant constraint in the hierarchy. It is apparent that the relevant constraint that plays a central role in deriving the basic generalisation here is ALIGN-RIGHT (77), a prosody-morphology interface constraint, which requires that the right edge of a stem coincide with the right edge of a syllable. As demonstrated in the previous chapter, in order for ALIGN-RIGHT to be fully satisfied, all the feature content of the input stem, as well as the root node, must have a correspondent in the output (cf. McCarthy 1993b; Lombardi 1995).

In the process of suffixation, the concatenation of stems with suffixes forces the alignment constraint ALIGN-RIGHT to interact with the syllable structure constraints, particularly ONSET and CODA COND. Section 3.2 examines the phenomena which are triggered by the conspiracy to satisfy ALIGN-RIGHT and ONSET.

The interaction between ALIGN-RIGHT and CODA COND is explored in §3.3. As shown earlier, Malay has a set of micro constraints of the CODA COND family, namely, ALIGN-STOP(K), ALIGN-RHOTIC and ALIGN-NASAL. These constraints are distinct, and therefore they are separately ranked with respect to ALIGN-RIGHT in the hierarchy.

Despite the fact that ALIGN-RIGHT is highly respected, it is a dominated constraint, and thus it can be violated under domination. The violation of ALIGN-RIGHT is compelled by the satisfaction of ALIGN-RHOTIC. Another instance of ALIGN-RIGHT violation is embodied in the phenomenon of Vowel Debuccalisation, and this is pursued in §3.4.

### 3.2 ALIGN-RIGHT and ONSET interaction

Malay has two V-initial suffixes, namely, /-an/ and /-i/, which crucially require an onset, since the language disfavours an onsetless surface syllable. Generally, the onsetless suffixes can get their onset from the preceding consonant of the stem in accordance with the Minimal

Onset Satisfaction Principle (Roca 1994). This parallels the case of prefixation in (49b): when V-initial stems concatenate with C-final prefixes, the onsetless stems get their onset from the preceding consonant (e.g. /bər+an̩kat/ 'to depart' becomes [bərən̩kat]).

In the case where the stem ends in a vowel, specifically a high vowel or a low vowel, a violation of ONSET can be avoided by syllabifying the high vocoid in the margin nodes (see §2.3). However, both of these regular strategies fail to operate here, because the satisfaction of ONSET in this way would compel a fatal violation of ALIGN-RIGHT. Essentially, in the process of suffixation with the V-initial suffixes /-an/ and /-i/, both ONSET and ALIGN-RIGHT must be satisfied simultaneously. This conspiracy triggers the phenomena generally referred to as Glottal Epenthesis, V-gemination and C-gemination.

### 3.2.1 Glottal Epenthesis and V-Gemination

We have seen in §2.3 that prevocalic, postvocalic and intervocalic high vowels within the root morphemes are parsed in the syllable margin to eschew an ONSET violation. Let us now examine whether such syllable parsing is applicable across stem-suffix juncture. In (114) I lay out some relevant examples, where the morphological process of suffixation brings together sequences of high and non-high vowels, in either order.

#### (114) a. Postvocalic position

/mula+i/	[mūlaʔi]	*[mūla]	'to begin'
/məŋ+gula+i/	[mǝŋgulaʔi]	*[mǝŋgula]	'to cause to sweeten'
/di+puna+i/	[dipuɳāʔi]	*[dipuɳā]	'to cause to own (passive)'
/di+suka+i/	[disukaʔi]	*[disuka]	'to cause to like (passive)'

#### b. Prevocalic position

/kə+tahu+an/	[kətahuwan]	*[kətahwan]	'know'
/kə+mahu+an/	[kəməhūwān]	*[kəməhwān]	'want'
/pər+kəlahi+an/	[pəkəlahi jan]	*[pəkəlahjan]	'fight'
/batu+an/	[batuwan]	*[batwan]	'mileage'
/aku+i/	[akuwi]	*[aʔwi]	'to acknowledge'

#### c. Intervocalic position

/pakai+an/	[pakaɟjan]	*[pakajan]	'cloth'
/kə+pandai+an/	[kəpandaɟjan]	*[kəpandajan]	'cleverness'
/gurau+an/	[gurawwan]	*[gurawan]	'joke'
/kə+pulau+an/	[kəpulawwan]	*[kəpulawan]	'islands'

Notice that the surface syllabification of high vowels across the stem-suffix boundary in (114) is different from the one within the root morphemes in (20) above. Given the schematic ranking we have established in §2.3, ONSET >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X, \*M/H, the grammar would predict the forms with the asterisk as more harmonic than the actual surface forms, as illustrated in the tableaux below.

(115) Postvocalic high vowel

/mula+i/	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. ☹ *mu.laj				*
b. ☺ mu.la.ʔi.		*!		
c. mu.la.i.	*!			

(116) Prevocalic high vowel

/kə+tahu+an/	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. ☹ *kə.tah.wan				*
b. ☺ kə.ta.hu.wan			*!	*
c. kə.ta.hu.an	*!			*

(117) Intervocalic high vowel

/pakai+an/	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. ☹ *pa.ka.jan				*
b. ☺ pa.kaj.jan			*!	*
c. pa.ka.i.an	**!			

As can be seen, candidates (115a), (116a) and (117a) are chosen as the optimal output, as they minimally violate the lowest constraint in the hierarchy. Nevertheless, the correct surface forms are (115b), (116b) and (117b), the candidates marked by '☺'. This suggests that the grammar must contain a constraint, superordinate to DEP-IO<sub>CONS</sub> and INTEGRITY-X, that dismisses the suboptimal candidates.

Before we offer an OT account, let us review how the generalisations in (114) are accounted for in the previous rule-based analyses. The phenomena in (114a) is captured in Farid (1980) by the Glottal Insertion rule in (118), where its structural description is conditioned by a suffix boundary '≡'. This rule is extrinsically ordered before the Marginal Vowel Derived Rule (38) (i.e Diphthongisation) in the derivation. The phenomena in (114b) and (114c) are handled by the rule of Glide Insertion, which is formalised as in (119). Similarly, this rule is extrinsically ordered before the Marginal Vowel Derived Rule (38).

(118) Glottal Insertion (Farid 1980:50)

$$\emptyset \rightarrow ? / \quad \text{V} = \text{___} \text{V} \\ \text{[-high]}$$

Condition: '≡' designates a suffix boundary'

## (119) Glide Insertion (Farid 1980:51).

$$\emptyset \rightarrow \left[ \begin{array}{l} - \text{syllabic} \\ - \text{consonantal} \\ + \text{high} \\ \alpha \text{ low} \\ \beta \text{ back} \end{array} \right] / \left( \begin{array}{c} \text{V} \\ + \text{high} \\ \alpha \text{ low} \\ \beta \text{ back} \end{array} \right) \text{ — } \text{V}$$

As commented on by Teoh (1994), rule (118) is morphologically conditioned and relies on extrinsic rule ordering. The formalism of rule (119), on the other hand, is very unconstrained and cumbersome. Thus, both are unmotivated, and therefore they should be discarded. Teoh (1994) then suggests that the occurrence of glottal stop in (114a) and the appearance of 'glides' in (114b) and (114c) are derived by a default rule (120) and a Glide Formation rule (121), respectively.

## (120) Glottal Insertion (Teoh 1994:76)

$$\begin{array}{c} ? \\ | \\ \text{X} \rightarrow \text{X} \end{array}$$

## (121) Glide Formation — spreading of feature [+high, α back] features

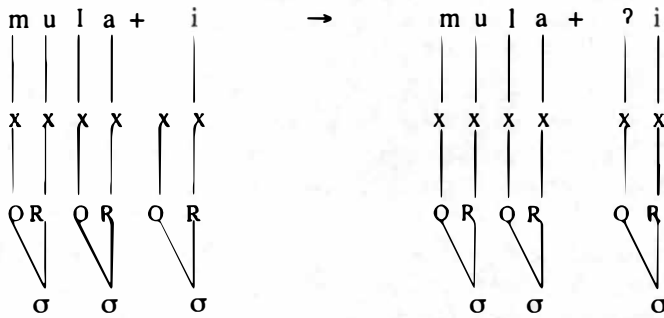
$$\begin{array}{ccc} \left( \begin{array}{l} + \text{high} \\ \alpha \text{ back} \end{array} \right) & & \left( \begin{array}{l} + \text{high} \\ \alpha \text{ back} \end{array} \right) \\ | & & | \text{---} \text{---} \text{---} \\ \text{X} & \text{X} & \rightarrow \text{X} \quad \text{X} \end{array}$$

As previously mentioned, Teoh (1994) crucially assumes that underlyingly the V-initial suffixes /-an/ and /-i/ possess an extra empty or featureless X-slot in the onset position (i.e. /-Xan/ and /-Xi/). This provision is in accordance with his primary claim that every underlying syllable in the language must have an onset. The empty onset X-slot then gets its melodic material from the preceding segment either through feature spreading or segmental linking.<sup>1</sup>

As can be seen in (121), the feature spreading rule is conditioned by a segment that is specified with [+high, α back] features. Obviously, this rule cannot apply in (114a) because the stem ends with a low vowel /a/, which lacks such feature values. Since nothing spreads, the empty X-slot of the V-initial suffixes is then filled with a glottal stop by default (120). This is to assure that no X-slot remains unassociated in the surface. How Glottal Insertion and Glide Formation are derived is illustrated in (122) and (123) below.

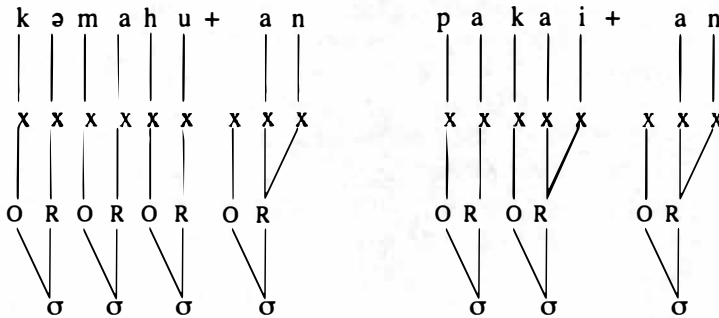
<sup>1</sup> The process of segmental linking creates a geminate across the stem-suffix juncture. We shall examine this phenomenon in §3.2.2.

(122) Glottal Insertion by default

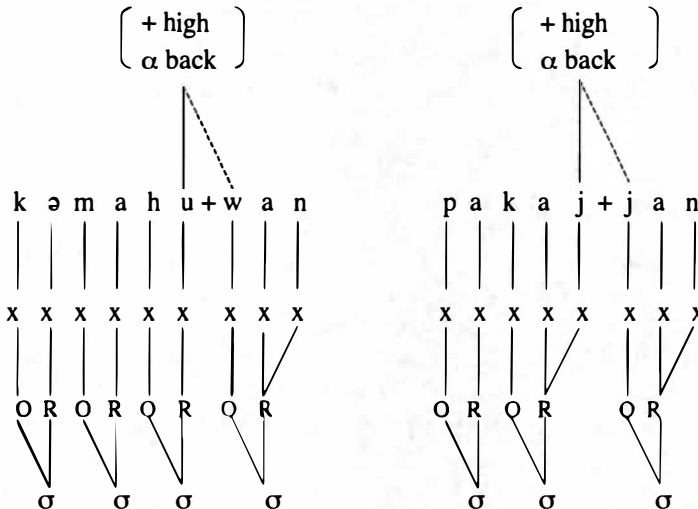


(123) Glide Formation – spreading of [+high, α back] features

a. Underlying melodies with syllabification



b. Feature spreading



As shown in the derivation, the phonological representation in (122) does not meet the structural description of the Diphthongisation rule (41). The presence of an empty onset X-slot between the /a+xi/ sequence blocks the reassociation of /i/ to the preceding vowel /a/. In short, Teoh's explanation is superior to Farid's in this respect, because the phonological representation itself explains the inapplicability of the rule.

Teoh (1994:76) argues that the rule of Feature Spreading in (121) only applies unidirectionally from left to right. This will block regressive feature spreading from taking place, otherwise the derivation would then yield an ungrammatical surface form such as \*[mulaji].

In our analysis, the emergence of a glottal stop in this context is a consequence of best satisfying the conflicting constraints in the hierarchy. It is clear that the structural motivation that underlies Glottal Epenthesis is the need to break up a hiatus, in keeping with the demand of the highly ranked ONSET constraint. The satisfaction of ONSET compels a violation of DEP-IO<sub>CONS</sub>.

Recall that /ai/ is a permissible diphthong in Malay. Hence, it is possible to parse /a+i/ tautosyllabically, escaping the consequence of both ONSET and DEP-IO<sub>CONS</sub> violations. The price of such parsing is a violation of the syllable structure constraint \*M/H. Since DEP-IO<sub>CONS</sub> outranks \*M/H in the hierarchy, tautosyllabification is preferred to Glottal Epenthesis. Given the input /mula+i/, we would expect that \*[mula<sub>j</sub>] is superior to the actual surface form [mulaʔi], as demonstrated in (115). The fact that this is not the desired result implies that tautosyllabification of /a+i/ across morpheme junctures is not permitted. Therefore, the grammar must have a constraint that rules out the coalescent candidates.

It is apparent that cross-morphemic syllabification has a significant effect on an alignment constraint of the prosody-morphology interface which requires that the edge of some grammatical category coincide with the corresponding edge of some prosodic category. Observe how, in the following examples, Glottal Epenthesis guarantees coincidence between the edge of the stem and the edge of a syllable, whereas coalescence locates the morphological stem-edge inside a syllable. The relevant stem-edge is marked by ' | ' and the syllable boundary is shown by a full stop ' . '.

(124) **Stem-Syllable Alignment.**

Input: /mula+i/      Output: a. [mu.la|.?i.]  
                              b. \*[mu.la|j.]

In OT, the distinction between matching and non-matching of stem/syllable edges is regulated under the formal constraint ALIGN-RIGHT (cf. McCarthy & Prince 1993a,b), which is formally defined as follows:

(125) ALIGN-RIGHT

Align (Stem, Right,  $\sigma$ , Right)


Constraint (125) resembles ALIGN-LEFT (50), which states that the right edge of a stem must coincide with the right edge of a syllable. Both constraints belong to the GENERALISED ALIGNMENT constraint family of the prosody-morphology interface, formalised in (51) above. In order for ALIGN-RIGHT to be fully satisfied, the final segment of the stem must be parsed at the right edge of a syllable. If tautosyllabification were to apply, the right edge of the stem would lie inside a syllable, causing a misalignment of the leading edges of the syllable and the stem.

A similar state of affairs exists in Axininca Campa (McCarthy & Prince 1993b) where the coalescence of /V+V/ is not permitted. Although /ai/ is a permissible diphthong in the language, a tautosyllabic parsing of /a+i/ is prohibited due to ALIGN-RIGHT. The hiatus is resolved by C-epenthesis, which guarantees coincidence of the stem-syllable edge.

In terms of hierarchical ranking ALIGN-RIGHT and ONSET are not ranked with respect to each other, because they do not show any conflict in the interaction. The relevant ranking to

account for Glottal Epenthesis at the stem-suffix juncture is as follows: ALIGN-RIGHT, ONSET >> DEP-IO<sub>CONS</sub> >> \*M/H.

(126) Glottal Epenthesis across stem-suffix juncture

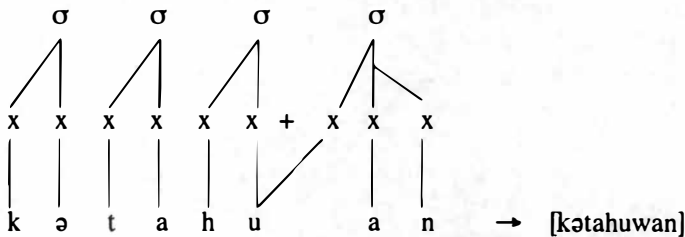
/mula+i/	ALIGN- RIGHT	ONSET	DEP- IO <sub>CONS</sub>	*M/H
a. mu.la i.i.		*!		
b. mu.la j.	*!			*
c.  mu.la ?i.			*	

It must be noted that the optimal candidate (126c) does not violate the undominated constraint ROOTCONTIG (63), since C-epenthesis takes place at the root edge and not root internally. Another potential candidate that needs to be considered is \*[mu.la|ji.]. This candidate obeys ALIGN-RIGHT and ONSET respectively. The emergence of the so-called 'glide' [j] here is the result of ambiskeletal parsing of the high vowel /i/. As established earlier, the ambiskeletal parsing spares DEP-IO<sub>CONS</sub>, but at the expense of violating INTEGRITY-X. This violation, however, cannot rule out the suboptimal output \*[mulaji] because INTEGRITY-X is ranked lower than DEP-IO<sub>CONS</sub>, as shown in (115), (116) and (117).

It is important to note that there is a significant structural difference between the ambiskeletal parsing developed earlier (i.e. /siap/ → [si.jap.]) and the one mentioned above (i.e. /mula+i/ → \*[mu.la.ji.]). In the former the two X's are dominated by two successive syllables, whereas in the latter they are under the same syllable. It has been observed cross-linguistically that an ambiskeletal parsing (cf. feature spreading in the rule-based analysis) must only be allowed to go rightward, crossing syllable boundaries, due to a widely observed constraint against ONSET-NUCLEUS HOMORGANICITY (Keer 1995; Thornburn 1995; McCarthy & Prince 1995b). This constraint rules out the failed candidate \*[mulaji].

Unlike tautosyllabic parsing, ambiskeletal parsing can apply across the morpheme boundary. As shown in (127) the stem-final high vowel occupies two different positions in two separate syllables. The question that arises from this is, does the output of ambiskeletal parsing satisfy ALIGN-RIGHT?

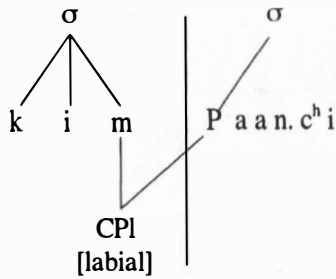
(127) Ambiskeletal parsing across stem-suffix juncture



As can be seen, the right edge of the stem coincides with two syllable edges, one on the right and the other on the left. There is a debate in the literature with respect to ALIGN-RIGHT and multiply linked structure at the stem-suffix boundary. In McCarthy and Prince's (1993a:39–40) analysis of Axininca Campa, it is argued that multiple linking in a case like (128) does violate ALIGN-RIGHT. As McCarthy and Prince (1993a:39) state, 'ALIGN requires sharply defined morpheme edges, but linking [as in (128)], undoes the desired relation between the morphological and prosodic constituency of a form'.



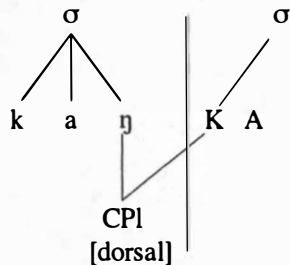
(128) \*[kimPaanchi], with multiple linking



This explains why the form /kim + aanchi/ surfaces as [ki.maan.c<sup>h</sup>i] instead of \*[kim.Paan.c<sup>h</sup>i]. Both violate ALIGN-RIGHT, and the former is more optimal because it does not incur a DEP-IO<sub>CONS</sub> violation.

On the other hand, in their analysis of Lardil, Itô and Mester (1994) affirm that a double-linked structure as in (129) does satisfy ALIGN-RIGHT in accordance with the notion of 'noncrisp' alignment. In Lardil, subminimal stems are augmented to fulfil the bisyllabic word minimality requirement (Prince & Smolensky 1993). Augmentation results in the addition of a whole new syllable, with an epenthesised vowel and an epenthesised onset consonant (homorganic with the preceding coda onset).

(129) [kaŋKA] with multiple linking



If ALIGN-RIGHT were violated in a case like (129) (as assumed by McCarthy and Prince (1993a) for the parallel situation in Axininca Campa, as in (128) above), we would expect \*[ka.ŋa] as the optimal candidate, as compared to the true surface form [kaŋ.ka]. If both violated ALIGN-RIGHT equally, the former would be better because it would not violate DEP-IO<sub>CONS</sub>. If on the other hand, there is no ALIGN-RIGHT violation then [kaŋ.ka] wins with ranking (in Lardil) of ALIGN-RIGHT >> DEP-IO<sub>CONS</sub>.

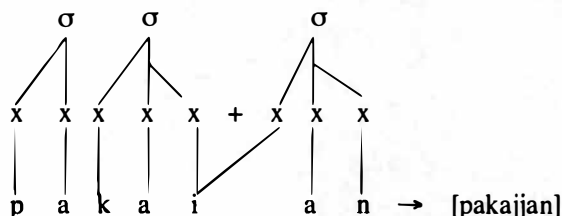
Following Itô and Mester (1994), I construe ALIGN-RIGHT as 'noncrisp', and in other words multiple linking in ambiskeletal parsing is not reckoned as an alignment violation. As we have shown earlier, multiple parsing only violates INTEGRITY-X and \*M/H (see §2.3.2). These constraints are dominated by DEP-IO<sub>CONS</sub> (see §2.3.2). Under this condition, Glottal Insertion can never be more harmonic than the multiple-linked syllabification in resolving the underlying hiatus.

(130) Ambiskeletal parsing across stem-suffix juncture

/kə+tahu+an/	ALIGN- RIGHT	ONSET	DEP- IO <sub>CONS</sub>	INTEG- RITY-X	*M/H
a. kə.ta.hu an		*!			
b. kə.tah.w an	*!				*
c. ☞ kə.tahu .wan				*	*
d. kə.ta.hu .ʔan			*!		

Notice that tautosyllabic parsing in candidate (130b) forces the stem-right edge to lie inside a syllable. This fatally violates ALIGN-RIGHT, as it causes a misalignment of the leading edges of the stem and the syllable. Although candidates (130a) and (130d) are well-aligned, they are both eliminated by virtue of the fact that they disobey the higher ranked ONSET and DEP-IO<sub>CONS</sub>, respectively. The multiple-linked candidate (130c) spares all the three constraints and is pronounced the victor. The ambiskeletal parsing we discussed thus far only involves the parsing of a high vowel in the nucleus and in the onset of two separate syllables. There is also a case where the high vowel is multiply parsed only in the marginal positions. To put it simply, the first X is assigned to the coda of the first syllable, and the second X to the onset of the following one. I call this a V-geminate because of its close resemblance to a C-geminate (see §3.2.2).

(131) Ambiskeletal parsing — V-geminate



Recall that an intervocalic high vowel within the root morpheme is parsed in the onset to avoid hiatus (see §2.3.2). For instance, forms such as /baɪam/ ‘spinach’ and /bauaŋ/ ‘onion’ surface as [ba.jam] and [ba.waŋ]. The intervocalic high vowel never undergoes ambiskeletal parsing, and therefore there is no V-geminate within the root morpheme such as \*[ba.j.jam] and \*[ba.w.waŋ]. This is expected because a structure with a single linking only violates \*M/H, whereas in the case of multiple parsing, in addition to the double violation of \*M/H, the candidate is violating INTEGRITY-X as well. Under such conditions, no matter how the two constraints are ranked, a multiple-linked candidate can never be optimal. However, the reverse state of affairs occurs at the stem-suffix juncture. A geminate candidate with multiple-linked structure is preferred to a candidate with a single linking, as shown in the tableau below.

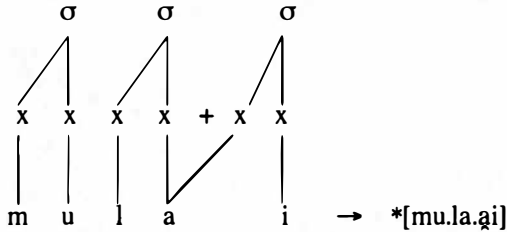
(132) V-geminate across stem-suffix juncture

/pakai+an/	ALIGN- RIGHT	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. pa.ka.jl.an		*!			*
b. pa.ka.jjan.	*!				*
c. pa.ka.jl.?an.			*!		*
d. $\sigma$ pa.ka.jl.jan				*	*

Observe that the tautosyllabic parsing of the intervocalic high vowel across the stem-suffix juncture forces the right edge of the stem to rest inside a syllable, as shown in candidate (132b). This results in a misalignment between the leading edges of the syllable and the stem, a fatal violation of ALIGN-RIGHT. Despite the fact that the losing candidates (132a) and (132c) are well-aligned, they are ruled out due to their violation of ONSET and DEP-IO<sub>CONS</sub>, respectively. The geminate candidate with doubly-linked association (132d) satisfies all the top three constraints, and therefore it is the most harmonic. The INTEGRITY-X violation compelled here is irrelevant, because the victor has already been determined.

In short, the conspiracy of ALIGN-RIGHT and ONSET forces the stem-final high vowel to be parsed ambiskeletally. An interesting question that arises from here is, why can't the low vowel /a/ undergo the same syllabic parsing, as represented in (133).

(133) Ambiskeletal parsing of low vowel



The potential candidate in (133) seems to be better than the optimal candidate with Glottal Epenthesis (i.e. [mu.la.ʔi]), as it eschews the DEP-IO<sub>CONS</sub> violation. The elimination of \*[mu.la.ɰi] in the competition can be straightforwardly explained if we invoke the earlier syllable structure constraint \*M/NH (22), which militates against the parsing of non-high vowels in the syllable margins. This constraint is unviolated, and therefore it is undominated in the constraint hierarchy.

(134) Glottal Epenthesis across stem-suffix juncture

/mula+i/	*M/NH	ALIGN- RIGHT	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X	*M/H
a. mu.la i.i.			*!			
b. mu.la j.		*!				*
c. mu.la ɰi	*!				*	
d. $\sigma$ mu.la ʔi.				*		

### 3.2.2 C-Gemination

As was mentioned, resyllabification is a common cross-linguistic strategy used to fulfil the Minimal Onset Satisfaction Principle (Roca 1994). In Malay, when V-initial stems concatenate with C-final prefixes, the onsetless stems always get their onset from the preceding consonant (i.e. /bər+an̩kat/ 'to depart' and /mər̩+an̩kat/ 'to lift' become [bə.ɾan̩.kat] and [mə.ɾan̩.kat]). Cross-junctural resyllabification, however, does not apply at the stem-suffix boundary, as shown in (135). This is another instance of the ALIGN-RIGHT effect.

(135)	/lətop+an/	[lətoppan]	'explosion'
	/ləŋkap+i/	[ləŋkappi]	'to cause to complete'
	/rambot+an/	[rambottan]	'a kind of fruit'
	/dəkat+i/	[dəkatti]	'to cause to come close'
	/tules+an/	[tulesan]	'writing'
	/atas+i/	[atassi]	'to cause to overcome'
	/kaseh+an/	[kasehhan]	'sympathy'
	/kaseh+i/	[kasehhi]	'to cause to adore'
	/kənal+an/	[kənāllan]	'friend'
	/səsal+i/	[səsalli]	'to cause to regret'

Notice that the stem-final consonant surfaces as a geminate in this environment. Before we proceed, it is important to note that Malay does not have underlying geminates. This is the only case where surface geminates occur in the language. Farid (1980:11) argues that the geminated forms in (135) are not manifested phonetically, as the language generally does not permit gemination of surface consonants. However, gemination of surface vowels does occur in his description, where forms like /kə+pulau+an/ 'archipelago' and /kə+pandai+an/ 'cleverness, skill' surface as [kəpulawwan] and [kəpandaijan],<sup>2</sup> respectively (cf. Farid 1980:52).

Teoh (1994:66), on the other hand, claims that geminated forms are clearly perceptible, even in fast speech. As pointed out by Teoh (1994:67), the gemination rule is one crucial piece of evidence that can help explaining the phenomenon of Debuccalisation (i.e. Glottal Formation 3.3.1) in suffixed forms, such as /masak+an/ and /baek+i/, pronounced [masaʔkan] and [baeʔki], respectively.

As described in Abdullah (1993), one of the characteristics of Malay pronunciation is that the final consonant of a stem is realised as a geminate when it is followed by the V-initial suffixes /-an/ and /-i/. Based on my own observations, I agree with Teoh (1994) and Abdullah (1993) that Malay does have cross-junctural geminated surface forms. Psychological evidence from a language game supports this observation. For example, words like [tulesan] 'writing' and [kasehhan] 'sympathy' are realised as [sanlestu] and [hansehka].

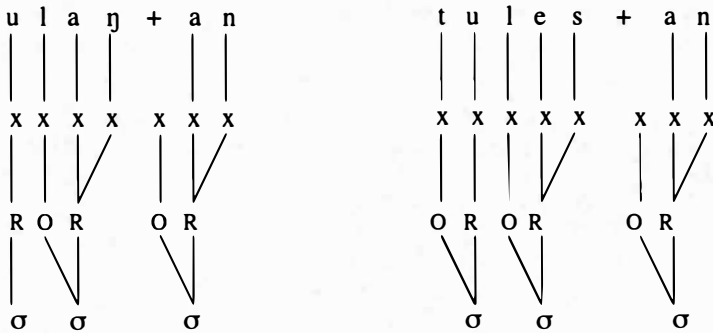
In Teoh's (1994) analysis, a geminate is derived by a process of linking the stem-final consonant to the empty X-slot of the V-initial suffixes. This process is closely parallel to the case of Glide Formation in (123). The derivation in (136), according to Teoh (1994:75), '... would account for all the geminated forms of stems ending in a consonant other than a voiceless velar stop when suffixed with /-Xan/ or /-Xi/'.<sup>3</sup>

<sup>2</sup> It must be noted that in Farid's (1980:52) transcription these forms are transcribed as [kəpulauwan] and [kəpandaiyan]. I have altered his transcription in this respect.

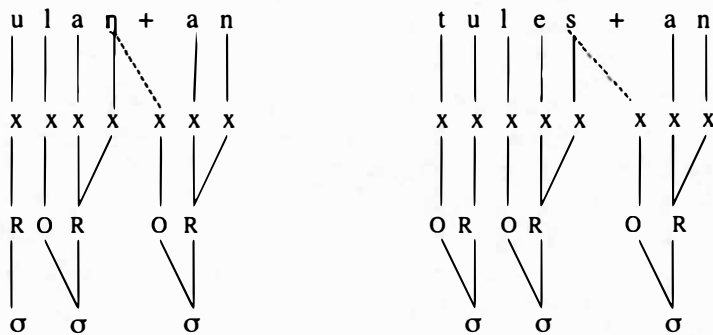
<sup>3</sup> In Teoh's analysis, a geminated voiceless velar stop will undergo another phonological rule before its final output form is derived. This particular segment needs to be exempted from the general rule because its phonological behaviour is distinct, and we shall explore this shortly in §3.3.

## (136) Gemination – linking of the C-final stem

## a. Underlying melodies with syllabification

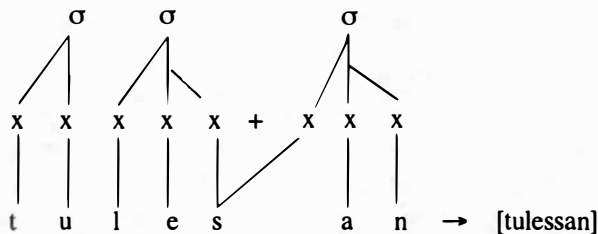


## b. Segmental linking



In our analysis, a C-geminate is formed in exactly the same fashion as a V-geminate (see §2.3.2), that is, the final segment of the stem undergoes ambiskeletal parsing, as represented in (137).

## (137) Ambiskeletal parsing: C-geminate



As can be seen, the geminate consonant arches across two syllable nodes. It is evident that C-gemination must be triggered by the higher-ranked constraint ONSET, which requires that every surface syllable must have an onset. Gemination is superior to Glottal Insertion (i.e. \*[tulesʔan]) because the former is more faithful to the input than the latter. Gemination respects the faithfulness constraint DEP-IO<sub>CONS</sub> at the expense of violating INTEGRITY-X, which militates against multiple correspondents between the input and the output.

As mentioned, when V-initial stems concatenate with C-final prefixes (49b), Minimal Onset Satisfaction (Roca 1994) is fulfilled by resyllabification. One of the advantages of resyllabification is that it can abstain from the violation of INTEGRITY-X. Remarkably,


resyllabified suffixed forms such as \*[tulesan] and \*[kasehan] are not the optimal outputs. This is another piece of evidence that shows that cross-junctural syllabification is prohibited at the suffix boundary (i.e. /C+V/ → \*[CV]), even though it is visibly active in other environments, in particular at the prefix-stem juncture.

Similarly to the previous case, the crucial constraint at play here is ALIGN-RIGHT (125), which requires that the right edge of a stem coincide with the right edge of a syllable. If resyllabification were to apply, the right edge of the stem would lie inside a syllable. This causes a misalignment of the leading edges of the syllable and the stem.

In sum, obedience to ALIGN-RIGHT can only be achieved, if the stem-final segment, whether a vowel or a consonant, occupies the syllable final position. As noted, ALIGN-RIGHT is crucially interpreted in our analysis as 'noncrisp' alignment (Itô & Mester 1994), and therefore multiple linking in geminates is not reckoned as an alignment violation.

It is absolutely clear that C-geminate and V-geminate are forced by a conspiracy of ONSET and ALIGN-RIGHT, particularly in the case where V-initial suffixes attach to stems. Both phenomena are regulated under the same constraint hierarchy, that is, ALIGN-RIGHT, ONSET >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X.

(138) C-Geminate across stem-suffix juncture

/tules+an/	ALIGN- RIGHT	ONSET	DEP- IO <sub>CONS</sub>	INTEG RITY-X
a. tu.les an		*!		
b. tu.le.s an.	*!			
c.  tu.les san				*
d. tu.les .ʔan			*!	

As shown, in the losing candidate (138b), the stem right edge ' | ' lies inside the syllable. This fatally violates ALIGN-RIGHT, as the leading edges of the stem and the syllable do not coincide. Candidates (138a) and (138d) are well-aligned, but they are ruled out because of the ONSET and DEP-IO<sub>CONS</sub> violations. The geminated candidate (138c) spares all these violations and emerges as the optimal output.

In conclusion, the satisfaction of ONSET by cross-junctural syllabification is not permitted at the suffix boundary, in order to respect the highly ranked alignment constraint ALIGN-RIGHT, which demands that the stem-final segment be syllable final. Thus, in order to satisfy ONSET and ALIGN-RIGHT simultaneously, the stem-final segment has to be multiply parsed, giving rise to the phonological phenomena known as V-gemination and C-gemination. In the case where ambiskeletal parsing is impossible, specifically for stems ending in a low vowel, as in (134), ONSET is satisfied by Glottal Epenthesis.

### 3.3 ALIGN-RIGHT and CODA COND interaction

As discussed in §2.5, although Malay syllables may have a single coda, there is a constraint in the language which prohibits a small class of segments from occupying the coda position. This prohibition is governed by the syllable structure constraint CODA COND. Following Itô and Mester (1994), the CODA COND constraint is being formalised in this study in terms of an alignment statement.

I have suggested that Malay crucially needs more than one CODA COND constraints, all subsumed under the CODA COND constraint family, namely, ALIGN-STOP(K), ALIGN-RHOTIC and ALIGN-NASAL. The crucial idea about the constraint family is that of a group of similar and related constraints, all built around a single broad concept, but separately rankable in the constraint hierarchy (Prince & Smolensky 1993). This is evident from the fact that illicit coda segments are resolved by different strategies, such as feature delinking, root node delinking and feature spreading.

In §2.5 we observed that the interaction between the CODA COND constraints and ALIGN-RIGHT gives rise to the following part of ranking hierarchy: ALIGN-STOP(K), ALIGN-RHOTIC >> ALIGN-RIGHT >> ALIGN-NASAL. In what follows, we shall examine how this ranking governs the alternations that occur at the stem-suffix boundary, such as Debuccalisation, r-Deletion, r-gemination, and Opacity of Nasal Assimilation and Nasal Coalescence.

### 3.3.1 ALIGN-STOP (K) satisfaction: Debuccalisation

I showed in §2.5.1 that Malay has a CODA COND constraint called ALIGN-STOP(K) (73), which bans the voiceless velar stop /k/ from occupying the coda of a syllable. When this consonant occurs in the coda position, the best way of eschewing the ALIGN-STOP(K) violation is by feature delinking. This strategy is called Debuccalisation (traditionally known as Glottal Formation). Since the segment /k/ is now realised as a glottal stop [ʔ] in the coda, ALIGN-STOP(K) is satisfied vacuously. The price paid for such alternation is a violation of the featural faithfulness constraint IDENT-IO[Place] and the alignment constraint ALIGN-RIGHT. The relevant ranking derived from this is ALIGN-STOP(K) >> ALIGN-RIGHT >> IDENT-IO [Place].


It must be mentioned that other plausible feature changing mechanisms, such as Spirantisation, where stops become fricative (i.e. /k/ → [x]), or Deoralisation, where oral stops become nasals (i.e. /k/ → [ŋ]), are ruled out by assuming that the IDENT-IO[F] constraints effected by such strategies, in particular IDENT-IO[Continuant] and IDENT-IO[Obstruent] are ranked higher in the hierarchy. To proceed, let us observe what happens to the stem-final /k/ when it occurs in suffixed forms.

(139) Underlying form	Surface form	
/masak/	[māsaʔ]	'to cook'
/masak+an/	[māsaʔkan]	'cooking, dish'
/masak+kan/	[māsaʔkan]	'cook (imperative)'
/galak/	[galaʔ]	'to encourage'
/galak+an/	[galaʔkan]	'encouragement'
/galak+kan/	[galaʔkan]	'encourage (imperative)'
/təpok/	[təpoʔ]	'to clap'
/təpok+an/	[təpoʔkan]	'applause'
/təpok+kan/	[təpoʔkan]	'clap (imperative)'
/pətek/	[pəteʔ]	'to pick'
/pətek+an/	[pəteʔkan]	'extract'
/pətek+kan/	[pəteʔkan]	'pick (imperative)'
/baek/	[baeʔ]	'good'
/baek+i/	[baeʔki]	'to repair'



Notice that there is homophony between the suffixed forms of the C-initial suffix /-kan/ and V-initial suffix /-an/. The alternation of  $k \sim ?$  before the prefix /-kan/ is phonologically expectable, since it conforms with the general strategy of Debuccalisation. Given the schematic ranking ALIGN-STOP(K), DEP-IO<sub>vow</sub> >> ALIGN-RIGHT >> MAX-IO<sub>cons</sub> >> IDENT-IO[Place] established in (79), the Evaluation correctly predicts that the debuccalised candidate is the most harmonic, as shown in tableau (140).

(140) Debuccalisation at the stem-suffix juncture

/masak+kan/	ALIGN-STOP(K), DEP-IO <sub>vow</sub>	ALIGN- RIGHT	MAX- IO <sub>cons</sub>	IDENT- IO[Place]
a. ma.sak .kan.	ALIGN-STOP(K) *!			
b. ma.sa.k ə.kan.	DEP-IO <sub>vow</sub> *!	*		
c. ma.sa.< > .kan.		*	*!	
d.  ma.sa? .kan. <plc>		*		*

As can be seen, although the losing candidate (140a) is well-aligned, it fatally violates ALIGN-STOP(K). The failed candidate (140b) is ruled out, as it incurs the DEP-IO<sub>vow</sub> violation. The competitive candidates (140c) and (140d) spare this violation, but disobey ALIGN-RIGHT equally. Thus, they are in a tie position, and subject to evaluation by the next available constraint MAX-IO<sub>cons</sub>, which rules out (140c) and pronounces (140d) as the winning candidate. A violation of IDENT-IO[Place] is not significant because the victor has already been determined.

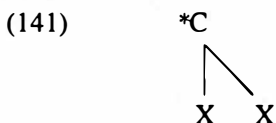
On the other hand, the occurrence of the consonant cluster [ʔk] before the suffix /-an/ needs further clarification and explanation. Before I offer an OT account, let us view how Debuccalisation in [ʔk] is accounted for in the rule-based analysis of Teoh (1994).

Generally, when C-final stems concatenate with V-initial suffixes, the stem-final consonant surfaces as a geminate (135). This generalisation is captured in Teoh (1994) as the result of linking the stem-final consonant to the empty X-slot of the V-initial suffixes (136). If Gemination were to apply to forms such as /masak+an/ and /baek+i/, the derivation would then yield the geminated forms \*[masakkan] and \*[baekki]. However, these forms are not the actual surface outputs.

Although Teoh (1994:74) does postulate a rule, the so-called Glottal Formation (72), this rule ought not apply in this particular environment, because it will violate the geminate integrity and inalterability conditions (Hayes 1986a), which prohibit any segment forming halves of geminates to undergo rules that they would be expected to undergo in a normal phonological application.

In Toba Batak (Hayes 1986b), a geminate that is derived by assimilation rule (i.e. spreading) fails to undergo Glottal Formation or Debuccalisation. This is due to the linking constraint (Hayes 1986a), which predicts that whenever the assimilation rule has applied, the double linkage that results should block Glottal Formation.

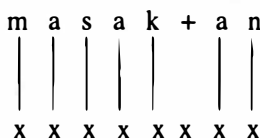
In order to be in agreement with this general principle, Teoh (1994:78) then posits an additional constraint that bars geminates, as in (141).



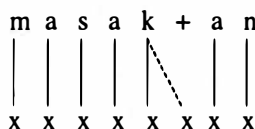
When a linking rule (136) creates a geminate which violates the constraint in (141), the structural representation is repaired by a minimal adjustment of the autosegmental linking, that is, by switching to the alternative representation with a single linking (Teoh 1994:78). Under this new representation, the singly-linked /k/ in coda position is accordingly glottalised by the Glottal Formation Rule in an obvious way, as the derivation in (142) demonstrates.

(142) Glottal Formation at the stem-suffix juncture

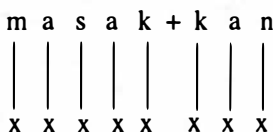
a. Underlying representation



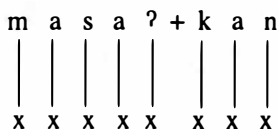
b. Linking rule



c. Readjustment autosegmental linking



d. Glottal formation



Although the derivation given above produces a correct output [masaʔkan], a crucial theoretical issue that arises here is that the proposed minimal readjustment linking structure (142c) is not independently motivated within the framework of autosegmental machinery. This rule also creates a serious analytical problem because it involves an OCP violation — adjacent identical segments are prohibited. As a result, Teoh's account for the occurrence of the consonant cluster [ʔk] at the suffix boundary in Malay is arbitrary and ad hoc, and therefore unsatisfactory.

In our analysis, no such an arbitrary device is needed. The emergence of [ʔk] in this particular environment is a consequence of best satisfying the conflicting constraints in the hierarchy. It is evident that the phonological motivation that underlies Debuccalisation before the V-initial suffixes is to satisfy three higher ranked constraints in the hierarchy, namely, ALIGN-RIGHT, ONSET and ALIGN-STOP(K).

Before we proceed, it is worth mentioning that it is not unusual for phonological rules to alter one half of a geminate, in apparent violation of the integrity principle. For example, in Icelandic (Thrainsson 1978) (cited in Kenstowicz 1994) voiceless stops are aspirated: /gata/ 'street' surfaces as [ga:tʰa]. When a voiceless stop is combined with a preceding consonant in a cluster, the aspiration shifts to the first member: /telpa/ 'girl' becomes [telpa] ([l] marks an aspirated liquid). This rule of aspiration shift also applies to a geminate, and followed by a debuccalisation process, so that /kappi/ 'hero' is realised as [kahpi]. The process of Debuccalisation in Icelandic is similar to Malay, except that in the former the C-geminate is underlying, whereas in the latter it is derived by ambiskeletal parsing (i.e. spreading).

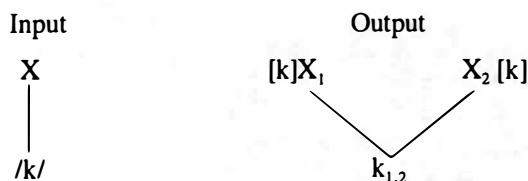
As demonstrated in the previous section, ambiskeletal parsing is triggered by a conspiracy of ONSET and ALIGN-RIGHT. In order for these two constraints to be fully satisfied, the final segment of the stem must be parsed ambiskeletally, that is, in the coda of one syllable and in the onset of the following one. Since the first X element occurs in the coda, it is subject to the CODA COND constraint. For the case under discussion, the first [k] in the coda is subject to ALIGN-STOP(K). It is worth noting that in the previous discussion, I have suggested that multiple linking in a geminate is not reckoned to violate an alignment constraint, particularly ALIGN-RIGHT, in agreement with to the notion 'noncrisp' alignment in Itô and Mester (1994).

Following this suggestion, an important question that arises — does multiple linking in a geminate satisfy the alignment constraint ALIGN-STOP(K)? Evidently, it doesn't, otherwise we would get the geminated forms such as \*[ma.sak.kan.] and \*[ba.ek.ki] as the optimal outputs. If that is the case, ALIGN-STOP(K) must be interpreted as a 'crisp' alignment constraint which requires a sharp edge alignment. As suggested in Itô and Mester (1994), both 'crisp' and 'noncrisp' alignment constraints are independently required in OT.<sup>4</sup> They are treated as two different constraints, and therefore separately rankable in the hierarchy. Itô and Mester (1994:37) state:

We propose that alignment constraints are indeed fulfilled in noncrisp linkage situation. At the same time there is a constraint favouring crisp edges of prosodic categories (we will call it 'Crisp Edge'): CrispEdge is formally independent of the various alignment constraints in terms of its function and its ranking with respect to other constraints.

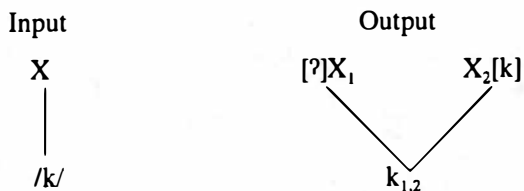
As far as the correspondence relation is concerned, both Debuccalisation (i.e. [ʔk]) and C-Gemination (i.e. [kk]) involve a one-to-two mapping from the input to the output — one input segment stands in correspondence with two output X-elements. This relationship can be depicted as follows:

(143) a. C-Gemination



<sup>4</sup> For example, ALIGN-RIGHT in Lardil is interpreted as a 'noncrisp' alignment, whereas for Axininca Campa is a 'crisp' alignment constraint (Itô & Mester 1994).

## b. Debuccalisation



Both forms are satisfying ALIGN-RIGHT and violating INTEGRITY-X equally. What makes the form [?k] a better candidate than [kk] must, therefore, be attributed to some other constraints. The relevant constraint is not hard to determine, namely, ALIGN-STOP(K).

As noted, I crucially assume that ALIGN-STOP(K) is a 'crisp' alignment constraint which requires a sharp edge alignment, that is, the voiceless velar stop [k] must precisely occupy the left periphery of a syllable. In other words, the consonant [k] must be parsed in the onset position. Following this assumption, ALIGN-STOP(K) is violated in the geminated form [k.k] (143a), since the leftmost [k] occupies the syllabic coda position. In the debuccalised form [?k] (143b), however, the leftmost segment is not [k], but [?], and therefore no such violation is encountered.

The schematic ranking ALIGN-STOP(K) >> ALIGN-RIGHT, ONSET >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X, IDENT-IO[Place] straightforwardly accounts for the phenomenon of Debuccalisation, as the following tableau illustrates.

## (144) Debuccalisation across stem-suffix juncture

/masak+an/	ALIGN-STOP(K)	ALIGN-RIGHT	ONSET	DEP-IO <sub>CONS</sub>	INTEGRITY-X	IDENT-IO[Place]
a. ma.sak .an.	*!		*			
b. ma.sa.k .an.		*!				
c. ma.sak .ʔan.	*!			*		
d. ma.sak .kan	*!				*	
e. ma.saʔ .kan					*	
f. ma.saʔ .ʔan <Plc>		*!			*	*

Notice that there is a significant difference between the optimal form [masaʔkan] in (144) and [masaʔkan] in (140). Although they have the same surface forms, they are phonologically distinct in terms of constraint satisfaction and violation, particularly with respect to ALIGN-RIGHT and IDENT-IO[Place].

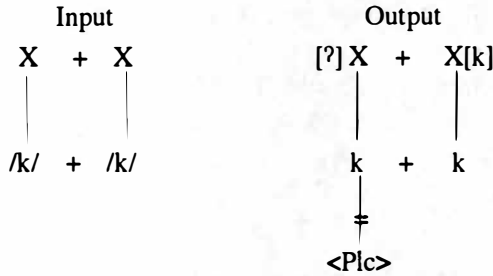
As suggested earlier (see §3.3.1), the alternation of the voiceless velar stop /k/ into a glottal stop [ʔ] involves a violation of the featural faithfulness constraint IDENT-IO[Place] (74), which requires that the correspondent of the input segment specified as [Place] must be [Place]. When IDENT-IO[Place] is violated, it directly effects ALIGN-RIGHT as well. In order for ALIGN-RIGHT to be fully satisfied, all the feature content of the stem, as well as the root node, must be faithfully parsed (cf. McCarthy 1993; Lombardi 1995).

I assume that the one-to-two mapping in (143b) and (144e) is not reckoned as violating IDENT-IO[Place]. The featural faithfulness constraint is not violated as long as the input segment specified as [Place] has an output correspondent which is also specified as [Place]. It

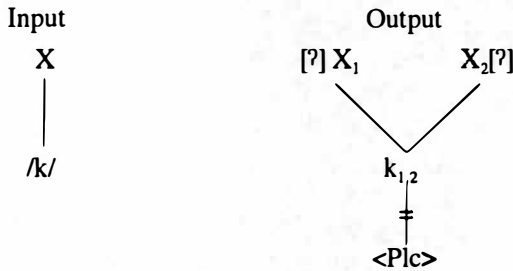
does not matter whether the input segment also corresponds to another output segment that lacks a feature [Place] specification. The one-to-two mapping in (143b) also satisfies ALIGN-RIGHT, since the feature [Place] of the stem is faithfully parsed in the onset of the following syllable.

IDENT-IO[Place] and ALIGN-RIGHT are certainly violated if the stem-final /k/ surfaces as a single glottal stop like in (140d) or a geminate glottal stop as in (144f). The diagrams in (145) clarify the points I just made.

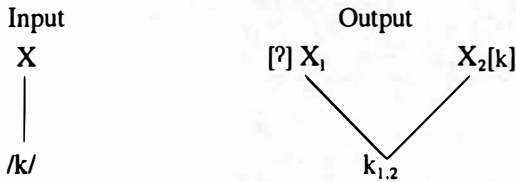
(145)a. ALIGN-RIGHT and IDENT-IO[Place] violations — a single parsing



b. ALIGN-RIGHT and IDENT-IO[Place] violations — a multiple parsing



c. ALIGN-RIGHT and IDENT-IO[Place] satisfactions — a multiple parsing



In sum, the phenomenon of Debuccalisation across stem-suffix boundary is regulated by two independent alignment constraints, namely, ALIGN-RIGHT and ALIGN-STOP(K). ALIGN-RIGHT is construed as a 'noncrisp' alignment constraint, and thus multiple linking in the ambiskeletal parsing is not reckoned as a violation. By contrast, ALIGN-STOP(K) is a 'crisp' alignment constraint, which requires a sharp edge alignment, that is, the voiceless velar stop [k] must precisely occupy the onset of a syllable. In order for both constraints to be fully satisfied, one part of the geminate undergoes Debuccalisation (to satisfy ALIGN-STOP(K)), and the other half preserves the input specification (to satisfy ALIGN-RIGHT).

### 3.3.2 ALIGN-RHOTIC satisfaction: *r*-Gemination, *r*-Deletion and compensatory lengthening

As observed in §2.5.3, when the stem-final /r/ gets deleted, the preceding vowels will then be lengthened.<sup>5</sup> This phenomenon is commonly referred to as compensatory lengthening, and is familiar in many Malay dialects (cf. Collins 1986; Zaharani 1991).<sup>6</sup> To proceed, let us examine the alternation that arises when stem-final /r/ occurs in suffixed forms.

(146)	/uker/	[uke:]	'to carve'
	/uker+an/	[ukerran]	'carving'
	/uker+kan/	[uke:kan]	'carve (imperative)'
	/ukor/	[uko:]	'to measure'
	/ukor+an/	[ukorran]	'measurement'
	/ukor+kan/	[uko:kan]	'measure (imperative)'
	/pasar/	[pasa:]	'market'
	/pasar+an/	[pasarran]	'stock market'
	/pasar+kan/	[pasa:kan]	'sell (imperative)'

As can be seen, the bared forms and the suffixed forms containing a C-initial suffix exhibit the same phonological behaviour, that is, the /r/ undergoes deletion followed by compensatory lengthening. In the case where the stems concatenate with a V-initial suffix, the /r/ will surface as a geminate [rr].

I have demonstrated that the deletion of /r/ in the coda is triggered by the CODA COND constraint called ALIGN-RHOTIC (90), which demands that the consonant /r/ be left aligned within a syllable. Unlike ALIGN-STOP(K), the best way of satisfying ALIGN-RHOTIC is by root node delinking (i.e. segmental deletion) rather than by a feature delinking mechanism. Deleting a stem-final segment can never bring a stem into agreement with ALIGN-RIGHT. Thus, the violation of ALIGN-RIGHT is compelled by the satisfaction of ALIGN-RHOTIC. The two constraints are in a conflict situation, and therefore they have to be ranked with respect to each other. The relevant ranking has to be ALIGN-RHOTIC >> ALIGN-RIGHT as the following tableau demonstrates.

(147) *r*-Deletion: ALIGN-RHOTIC >> ALIGN-RIGHT

/pasar+kan/	ALIGN-RHOTIC	ALIGN-RIGHT
a. pa.sar .kan	*!	
b. ☞ pa.sa:.<> kan		*

The failed candidate (147a) is well-aligned, but the presence of /r/ in the coda fatally violates ALIGN-RHOTIC. The optimal candidate (147b) spares this violation at the expense of violating ALIGN-RIGHT. As can be seen, the right edge of the stem ' | ' does not coincide with the right edge of a syllable ' . ', because they are separated by an angled bracket '<>', which indicates a segmental deletion.

<sup>5</sup> It must be noted that the coda /r/ in root internal position is always preserved as a consequence of satisfying the undominated constraint ROOTCONTIG.

<sup>6</sup> The deletion of the prefix /r/ is never accompanied by compensatory lengthening. See §4.6. for details. It must also be noted that in Farid's analysis there is no compensatory lengthening.

It is worth noting that V-insertion (i.e. [pa.sa.rə.kan]) is another alternative to eschew the ALIGN-RHOTIC violation. But, this option serves no better than C-deletion because it equally violates ALIGN-RIGHT. The preference of C-deletion over V-insertion in this particular case can be captured by the schematic ranking DEP-IO<sub>VOW</sub> >> MAX-IO<sub>CONS</sub>.

As noted earlier (see §2.2), V-deletion/V-epenthesis and C-deletion/C-epenthesis have a very different status in Malay, given the fact that a vowel can never be deleted when it conflicts with the structural constraints. To capture this generalisation, two different constraints of MAX-IO and DEP-IO, namely, MAX-IO<sub>VOW</sub>/MAX-IO<sub>CONS</sub> and DEP-IO<sub>VOW</sub>/DEP-IO<sub>CONS</sub> are postulated. These constraints are distinct, and therefore they are separately ranked in the hierarchy. Crucially, vowel faithfulness constraints always dominate their consonant counterparts.

Another important observation that must not be missed is the compensatory lengthening. When the coda /r/ is deleted, the preceding vowel gets lengthened. As previously shown, this phenomenon is derived as the consequence of parsing the X to the preceding vowel in compliance with the demand of MAX-IO<sub>x</sub> (93), a faithfulness constraint that belongs to the MAX-IO constraint family, which demands that the X in the input must have a correspondent in the output. The satisfaction of MAX-IO<sub>x</sub> compels a violation of NLV, which militates against long vowels.

Considering all the constraints mentioned above, the relevant ranking is as follows: DEP-IO<sub>VOW</sub>, ALIGN-RHOTIC >> ALIGN-RIGHT >> MAX-IO<sub>x</sub>, MAX-IO<sub>CONS</sub> >> NLV.

(148) r-Deletion and compensatory lengthening

/pasar+kan/	DEP- IO <sub>VOW</sub>	ALIGN- RHOTIC	ALIGN- RIGHT	MAX- IO <sub>x</sub>	MAX- IO <sub>CONS</sub>	NLV
a. pa.sar .kan.		*!				
b. pa.sa.r ə.kan.	*!		*			
c. pa.sa.< > kan.			*	*!	*	
d. ☞ pa.sa.:< > kan			*		*	*

Despite the fact that the overparsed candidate (148b) survives ALIGN-RHOTIC, it is eliminated due to the fatal violation of DEP-IO<sub>VOW</sub>. The loosing candidate (148c) deletes the stem-final /r/, and the X-slot is stray erased. This option disobeys ALIGN-RIGHT, MAX-IO<sub>CONS</sub> and MAX-IO<sub>x</sub>. Although candidate (148d) violates ALIGN-RIGHT as well as MAX-IO<sub>CONS</sub>, it incurs no violation of MAX-IO<sub>x</sub>, and thus it becomes the sole winner of the competition. As usual, the violation of the lower ranked NLV becomes irrelevant once the victor is pronounced.

Another potential candidate that must be taken into consideration is \*[pasarran]. This candidate preserves the stem-final /r/ and deletes the suffix-initial /k/ instead. The remaining X-slot of the suffix is associated to the stem-final /r/, and this gives rise to an r-geminate, as illustrated in (149). Gemination violates INTEGRITY-X, which prohibits multiple-linked representation.







Although the loosing candidate (154a) is well-aligned with respect to ALIGN-SUFF, it fatally disobeys the higher ranked ALIGN-RHOTIC and ONSET. The candidates (154c) and (154d) avoid these violations, but equally disobey ALIGN-SUFF, since the left edge of a suffix ' | ' does not coincide with the left edge of a syllable ' . '. This means that the two candidates are in a tie position, and thus the next available constraint has to be consulted. Candidate (154d) is ruled out because of not being obedient to ALIGN-RIGHT, and candidate (154c) is therefore the sole winner of the competition.

### 3.3.3 ALIGN-NASAL violation: opacity of Nasal Assimilation and Nasal Coalescence

Thus far we have seen that the CODA COND constraints ALIGN-STOP(K) and ALIGN-RHOTIC are fully obeyed in the optimal output of a suffixed form. Both constraints dominate ALIGN-RIGHT and ALIGN-SUFF in the hierarchy. In what follows we shall observe how ALIGN-RIGHT and ALIGN-SUFF interact with the next CODA COND constraint called ALIGN-NASAL. To begin, let us examine the data displayed in the table below.

(155)	/tanam/	[tanām]	'to bury'
	/tanam+an/	[tanāmmān]	'plant'
	/tanam+kan/	[tanāmkān] *[tanāŋkān]	'bury (imperative)'
	/hitam/	[hitām]	'black'
	/kə+hitam+an/	[kəhitāmmān]	'blackish'
	/hitam+kan/	[hitāmkān]	'blacken (imperative)'
	/təkan/	[təkān]	'to press'
	/təkan+an/	[təkānnān]	'pressure'
	/təkan+kan/	[təkānkān] *[təkaŋkān]	'press (imperative)'
	/makan/	[mākān]	'to eat'
	/makan+an/	[mākānnān]	'food'
	/makan+kan/	[mākānkān] *[mākaŋkān]	'eat (imperative)'

All the previous studies affirmed that a nasal segment which forms the coda of the first syllable is always homorganic to a following onset obstruent, and this fact is captured by a very general rule called Nasal Assimilation (Farid 1980:13; Teoh 1994:101). This generalisation, however, does not hold at the suffix boundary, as can be seen in (157).

In the process of affixation with the suffix /-kan/, Nasal Assimilation fails to apply, otherwise we will get incorrect surface forms, as indicated by the asterisk. Given the formalism formulated in the rule-based analysis, the opacity of Nasal Assimilation in this particular environment is very difficult if not impossible to account for. Arguably, this is the main reason why this well observed phonological fact has been overlooked in Teoh (1994). Farid (1980:13), on the other hand, regards this as an exception to the regular rule, as he notes, 'Nasals always appear on the surface as homorganic to a following consonant, except in cases of reduplication, or if the cluster consists that of nasal plus suffix-initial consonant [kan]'.

Given an OT account, the opacity of Nasal Assimilation at the suffix juncture is not merely exceptional but is an explainable phenomenon. Nasal Assimilation is blocked as a consequence of a candidate output best satisfying the constraint hierarchy, in accord with the theoretical assumptions of OT.


It is a well accepted fact that Nasal Assimilation in natural languages is triggered by the CODA COND constraint (McCarthy & Prince 1993a,b, 1994; Itô & Mester 1994). In our analysis this constraint is referred to as ALIGN-NASAL (101), which penalises any occurrence of specified Cplace nasal in the coda. We have observed in §2.5.4 that Malay does allow specified Cplace nasal segments occur in the word final coda, an instance of ALIGN-NASAL violation.

Possible strategies such as deletion (violation of MAX-IO<sub>CONS</sub>) and feature delinking rule (violation of IDENT-IO[Place]) which are visibly active in the language never apply here. These possibilities are blocked by ALIGN-RIGHT. As noted (see §3.2), in order for ALIGN-RIGHT to be fully satisfied, all the feature content of the stem, as well as the root node, must be faithfully parsed.

Unlike ALIGN-STOP(K) and ALIGN-RHOTIC, ALIGN-NASAL must be dominated by ALIGN-RIGHT in the hierarchy. As was mentioned, although the three CODA COND constraints belong to the same family, they are entirely distinct, and therefore they are separately ranked.

To account for the occurrence of specified Cplace nasal segments in the word final coda, I have established the following partial constraint hierarchy (as in §2.5.4): DEP-IO<sub>VOW</sub> >> ALIGN-RIGHT >> ALIGN-NASAL >> MAX-IO<sub>CONS</sub> >> IDENT-IO[Place].

(156) ALIGN-NASAL violation word finally

/tanam/	DEP- IO <sub>VOW</sub>	ALIGN- RIGHT	ALIGN- NASAL	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. ta.na.<		*!		*	
b. ta.na.m ə.	*!	*			
c. ta.nã. <Plc>		*!			*
d.  ta.nam .			*		


The failed candidate (156c) undergoes place delinking, not C-Deletion, and therefore it spares MAX-IO. The delinking of the Place node leaves behind a nasal element. This nasal element docks to the preceding vowel deriving a nasalised vowel [tanã].<sup>7</sup> Delinking crucially violates ALIGN-RIGHT, which requires that all the specified features of the right edge segment must be parsed. The only candidate that survives ALIGN-RIGHT is (156d), which inevitably emerges as the victor.

Notice that in combination with the C-initial suffix /-kan/, the final nasal consonant does not assimilate with the following obstruent. If Nasal Assimilation were to apply, this will involve delinking of the [Place] node of the stem-final nasal followed by spreading of the [Place] node of the following consonant. As noted, feature delinking crucially violates ALIGN-RIGHT, which requires that all the feature content of a stem, particularly the right edge segment to be faithfully parsed.

By imposing the same constraint ranking in (156), the interaction straightforwardly explains why Nasal Assimilation is opaque at the stem-suffix boundary. The Evaluation reveals that the assimilated candidate is not the one best satisfying the constraint hierarchy, as shown in tableau (157).

<sup>7</sup> This phonological phenomenon occurs in many Malay dialects, such as Kelantan dialect and Terengganu dialect (Teoh 1994; Trigo 1991).

## (157) ALIGN-NASAL violation — opacity of Nasal Assimilation


/tanam+kan/	DEP- IO <sub>vow</sub>	ALIGN- RIGHT	ALIGN- NASAL	MAX- IO <sub>cons</sub>	IDENT- IO[Place]
a. ta.na.<> kan		*!		*	
b. ta.na.m ə.kan	*!	*			
c. ta.naŋ .kan <Plc>		*!			*
d.  ta.nam .kan			*		

In candidate (157c), the underlying nasal /m/ surfaces as [ŋ] due to Nasal Assimilation, which involves delinking and spreading of the Place node. Delinking violates the featural faithfulness constraint IDENT-IO[Place]. A more serious effect of delinking is a fatal violation of ALIGN-RIGHT. The optimal candidate (157d) is featurally faithful to the input, and thus it obeys ALIGN-RIGHT at the expense of disobeying the CODA COND constraint ALIGN-NASAL.

Notice that the optimal candidate (157d) satisfies ALIGN-SUFF as well, since the left edge of the suffix coincide with the left edge of a syllable. ALIGN-SUFF is construed in the present study as a ‘crisp’ alignment constraint, which requires sharply defined morpheme edges. Multiple linking in place linked clusters is counted as a violation of ALIGN-SUFF. In short, the opacity of Nasal Assimilation at the suffix boundary is due to the conspiracy to satisfy ALIGN-RIGHT and ALIGN-SUFF simultaneously.

In the case of suffixation with V-initial suffix, ALIGN-SUFF has to be sacrificed in order to assure that ONSET is fully satisfied. When the demand for ALIGN-RIGHT and ALIGN-NASAL satisfactions is also at stake, the best way of achieving this is by parsing the stem-final nasal ambiskeletonally, and this gives rise to nasal gemination. The tableau in (158) demonstrates the points I just made.

## (158) Nasal-gemination across stem-suffix juncture

/tanam+an/	ONSET	ALIGN- SUFF	ALIGN- RIGHT	ALIGN- NASAL	INTEG RITY-X
a. ta.nam .an	*!			*	
b. ta.nam .ʔan		*		*!	
c.  ta.nam .man		*			*
d. ta.na.m .an		*	*!		

Another significant aspect of the behaviour of the nasal clusters at the suffix boundary that has not been addressed in the literature is the opacity of Nasal Coalescence. Following Pater (1999), Nasal Coalescence is construed in this study as a process of merging a nasal and a voiceless obstruent driven by a universal and violable constraint \*NÇ, which prohibits nasal/voiceless obstruent sequences.<sup>8</sup> In Malay, this process is very regular and productive at the prefix juncture.


<sup>8</sup> In Farid (1980) and Teoh (1994) this process is treated as two separate, but related rules which are extrinsically ordered, namely, Nasal Assimilation and Voiceless Obstruent Deletion. We shall discuss this process in more detail in §4.5.

- (159) /məŋ+pukol/ [māmūkōl] \*[māmpukol] 'hit (active)'  
 /məŋ+taŋkap/ [māntāŋkap] \*[māntaŋkap] 'catch (active)'  
 /məŋ+kumpol/ [māŋūmpol] \*[māŋkumpol] 'collect (active)'  
 /məŋ+kaioh/ [māŋājoh] \*[māŋkajoh] 'paddle (active)'

Typological studies show that nasal/voiceless obstruent clusters are disfavoured in many languages. One of the possibilities that languages use to resolve the occurrence of these clusters is Nasal Coalescence. In Correspondence Theory (McCarthy & Prince 1995b), the process of merging both the nasal and the voiceless obstruent is interpreted as a two-to-one mapping from the input to the output — two input segments stand in correspondence with a single output segment.

Since there is no deletion, Nasal Coalescence is not counted as a violation of MAX-IO<sub>CONS</sub>. In addition to the satisfaction of \*NÇ, Nasal Coalescence can also help to achieve the satisfaction of ALIGN-NASAL, as the nasal segment is now parsed to the left periphery of a syllable. However, a serious consequence of Nasal Coalescence is that it fatally violates ALIGN-RIGHT and ALIGN-SUFF.

- (160) Opacity of Nasal Coalescence — e.g. /pasəŋ+kan/ 'to fix'

/pasəŋ+kan/	DEP- IO <sub>VOW</sub>	ALIGN- SUFF	ALIGN- RIGHT	ALIGN- NASAL	MAX- IO <sub>CONS</sub>	*NÇ
a. pa.sa.< > kan.			*!		*	
b. pa.sa.ŋ ə.kan.	*!		*			
c. pa.saŋ .ŋan		*!			*	
d. pa.sa.ŋ an.		*!	*			
e.  pa.saŋ .kan.				*		*

The failed candidate (160d) undergoes Nasal Coalescence, that is, the cluster /k/ is fused together and becomes a velar nasal /ŋ/. As can be seen, the consequence of this is that the stem-edge and the suffix-edge do not coincide with a syllable boundary, a fatal violation of ALIGN-RIGHT and ALIGN-SUFF. In short, the opacity effect of certain regular phonological processes at the suffix boundary is not an irregular phenomenon. The visibly active processes are inapplicable as a consequence of a candidate output to best satisfy the constraint hierarchy.

### 3.4 Vowel Debuccalisation

The phonology of the native vocabulary demonstrates that there is a distributional restriction that prohibits the low vowel [a] from occupying the word final position. The underlying low vowel /a/ word finally is generally reduced to a schwa [ə]. However, in the suffixed forms of words, the /a/ retains its basic form and surfaces as [a]. The resulting morphophonemic alternation a ~ ə is a characteristic of the contemporary standard pronunciation of Malay.<sup>9</sup>

<sup>9</sup> As noted in the introductory chapter, orthographic <a> is pronounced as a low back vowel [a] word finally in literary Malay. In 1988, the *Dewan Bahasa dan Pustaka* (the Government's Language Planning Agency) has ruled that the standard pronunciation of Malay must be based on literary Malay.

## (161) Malay a ~ ə alternation

/duga/	[dugə]	'to test'
/duga+an/	[dugaʔan]	'testing'
/suka/	[sukə]	'to like'
/kə+suka+an/	[kəsukaʔan]	'favourite'
/mula/	[mūlə]	'to begin'
/mula+i/	[mūlaʔi]	'to cause to begin'
/tʃinta/	[tʃintə]	'to love'
/tʃinta+i/	[tʃintaʔi]	'to cause to love'

To account for the phenomenon of a  $\sim \text{ə}$  alternation at the word final position, Farid (1980) and Teoh (1994) postulate a rule called Vowel Reduction, which is respectively formulated as a linear rule (162) and a non-linear rule (163). Both rules state that the vowel /a/ will be reduced to a schwa when it is in a word final position.

(162) Vowel Reduction (Farid 1980:47)

$$a \rightarrow a / \_\_\_\#$$

(163) Vowel Reduction (Teoh 1994:48)

$$/a/ \rightarrow [ə] / \text{---} \\ \quad \quad \quad | \\ \quad \quad \quad V \#$$

Recall the rule of r-Deletion (see §2.5.3), which deletes the segment /r/ in word final position. It must be noted that in Farid's (1980) analysis, the deletion of /r/ in this environment is never followed by compensatory lengthening. Thus, the application of r-Deletion has an opacity effect on the Vowel Reduction rule, as the following examples show.

(164) r-Deletion in Farid (1980:47)

/bakar/	[baka]	'burn'
/tukar/	[tuka]	'change'
/kisar/	[kisa]	'revolve'
/hindar/	[hinda]	'avoid'

Notice that the output forms end with a low vowel as the result of r-Deletion. This representation certainly meets the structural description of Vowel Reduction rule. However, the rule fails to apply in this particular environment. Under his linear analysis, Farid (1980:48) accounts for this fact by imposing an extrinsic counterfeeding rule ordering, that is, Vowel Reduction precedes r-Deletion.

Farid (1980:48) noted that the extrinsic rule ordering analysis, being language-specific, is too costly. He then proposed an alternative solution couched in the global rule approach. The basic assumption of this approach is that some phonological rules apply under conditions that cannot be stated solely in terms of the immediate input string; derivationally earlier or later forms of the string may also have to be taken into consideration (Farid 1980:85). Under this analysis, the rule of Vowel Reduction is now formalised as in (165).



(165) Vowel Reduction (Farid 1980:92)

$a \rightarrow \text{ə} / \_\_\_ \#$   
 [- derived]

The rule states that the vowel /a/ reduces to [ə] in word final position only if it is underlyingly stem-final. The inclusion of the derivational history specification in (165) would now justify the failure of r-Deletion to feed Vowel Reduction no matter in which order the rules are applied.

In Teoh's (1994) analysis, the deletion of the stem-final /r/ is always accompanied by compensatory lengthening. I agree with Teoh (1994) in this respect, and it is obvious that Farid's r-Deletion rule seems to be oversimplified. As previously noted, this particular type of vowel lengthening is very common in many of Malay dialects (cf. Collins 1986; Zaharani 1991).

Under Teoh's (1994) multi-linear analysis, the whole phonological process seems to be much simpler without any extrinsic ordering and global devices, and is much more generalisable. As Teoh (1994:49) points out:

The vowel reduction rule written as a non-linear rule as above will prevent the [a:] in [baka:, tuka:, kisa: and hinda:] from changing to a schwa even though ... that they are at word final position. The vowel [a:] fails to undergo vowel reduction because it is now long or multiply attached to two-X-slots instead of one; its [the rule's] structural description is not met and the vowel reduction rule fails to apply and this correctly predicts the data above. A non-linear analysis therefore is descriptively and explanatorily more adequate than a linear analysis.

Given a multi-linear phonological representation, the following derivation gives a clear illustration of the interaction between r-Deletion, Vowel Lengthening and Vowel Reduction.

(166) Input Representation /bakar/ 'to burn'

r-Deletion

b a k a r  
 | | | | |  
 x x x x x

Vowel Lengthening

b a k a  
 | | | |  
 x x x x x

Vowel Reduction

inapplicable

Phonetic Representation

[b a k a:]  
 | | | |  
 x x x x x

/gula/ 'sugar'

inapplicable

g u l a  
 | | | |  
 x x x x  
 ↓  
 ə

[g u l ə]  
 | | | |  
 x x x x

Both Farid (1980) and Teoh (1994) construe Vowel Reduction as a segmental rule. It is quite common cross-linguistically that Vowel Reduction is associated with stress. For instance, vowel reduction to schwa in unstressed position occurs in English (Kenstowicz 1994:159): for example, [æ] → [ə] in *átom*, *atómic*.

In Malay, the main stress generally falls on the penultimate syllable (cf. Prentice 1987; Teoh 1994). If the penultimate syllable has a schwa, then the main stress falls on the following syllable. This is quite closely parallel to Indonesian stress (cf. Cohn & McCarthy 1994). There is no secondary stress in the language.

(167)	/baca/	[bácə]	'to read'
	/baca+an/	[bacáʔan]	'reading'
	/suka/	[súkə]	'to like'
	/kə+suka+an/	[kəsukáʔan]	'favourite'
	/mula/	[múlə]	'to begin'
	/mula-i/	[muláʔi]	'cause to begin'
	/bahasa/	[bahásə]	'language'
	/kə+bahasa+an/	[kəbahasáʔan]	'language'
	/bahaia/	[bahájə]	'dangerous'
	/ucap/	[úcap]	'to speak'
	/pantas/	[pántas]	'quick'
	/təlan/	[təlán]	'to swallow'
	/təndaŋ/	[təndán]	'to kick'
	/gali/	[gáli]	'to dig'
	/baru/	[báru]	'new'

In the segmental analysis, the inapplicability of Vowel Reduction rule in the suffixed forms is readily expected since its structural description is not met. In the prosodic analysis, however, the stem-final /a/ does not get reduced simply because it is now stressed. Despite the fact that the latter can capture the generalisation quite naturally, it is not a good solution as far as the Malay phonology is concerned. If Vowel Reduction is triggered by the unstressed syllabic position, then the rule should apply to other vowels as well. Remarkably, this is not the case. The rule is restricted to the low vowel /a/. Furthermore, the unstressed low vowel /a/ must occur in a light syllable at word final position. Considering this constraint, the segmental analysis seems to be more applicable. In the present study, I propose a constraint NO-LIGHT [a], which is formalised as in (168) below.

(168) NO-LIGHT [a]



Constraint (168) states that a low vowel [a] in a light syllable word finally is prohibited. Potentially, there are three possible ways of eschewing the NO-LIGHT[a] violation, namely, by feature delinking, C-insertion and V-deletion. None of these strategies can bring a stem into agreement with ALIGN-RIGHT.

(169) Stem-syllable alignment


Input: /mula/

Output: a. \*[mu.la|?]  
b. \*[mul.<>|]  
c. [mu.lə|.]  
    <Plc>

All the three candidates violate ALIGN-RIGHT and equally satisfy NO-LIGHT[a]. Thus, they are in a tie position, as far as the two constraints are concerned. The elimination of (169a) and (169b), therefore, must be governed by other constraints. The application of C-insertion in the former violates DEP-IO<sub>CONS</sub>, while the absence of the final vowel in the latter disobeys MAX-IO<sub>VOW</sub>. Candidate (169c) undergoes Debuccalisation, a rule that delinks the [VPlace] node of a vowel. Debuccalisation of a vowel gives rise to a schwa (Kenstowicz 1994a:159). Thus, the vowel schwa in Malay lacks any distinctive specification for the feature [Place] (i.e. height and backness) (cf. Teoh 1994). As usual, the price paid for feature delinking is a violation of the featural faithfulness constraint IDENT-IO[Place].

Of course, there are other plausible feature changing rules, such as the low vowel /a/ becomes high (i.e. /a/ → [u]) or mid (i.e. /a/ → [o]). These possibilities are ruled out by assuming that the IDENT-IO[F] constraints involved in such alternations, are ranked higher in the hierarchy. For present purposes, the relevant constraints are ranked as follows: MAX-IO<sub>VOW</sub>, NO-LIGHT[a] >> ALIGN-RIGHT >> DEP-IO<sub>CONS</sub> >> IDENT-IO[Place].


(170) Vowel Debuccalisation

/mula/	MAX- IO <sub>VOW</sub>	NO- LIGHT[a]	ALIGN- RIGHT	DEP- IO <sub>CONS</sub>	IDENT- IO[Place]
a. mu.la .		*!			
b. mu.la ?.			*	*!	
c. mul.<>	*!		*		
d.  mu.lə . <Plc>			*		*

Vowel Debuccalisation in (170) reminds us of the process of Consonant Debuccalisation, in particular of the alternation of k ~ ʔ, which reflects the same strategy. The generalisation that can be drawn from here is that the phenomena resolved by a feature delinking mechanism are governed by the same formal constraint, namely, IDENT-IO[Place].

To proceed, let us examine the position of /a/ in the suffixed forms. As can be seen in the examples given in (167), the low vowel /a/ now occupies a word medial position. Under this environment, it is not subject to the constraint NO-LIGHT[a], and therefore the vowel /a/ retains its phonetic form as [a]. In other words, the constraint NO-LIGHT[a] is not active in the suffixed form, since its target segment never occurs in word final position. Thus, it is vacuously satisfied by all the candidates.


## (171) [a] preservation in the suffixed form

/mula-i/	MAX- IO <sub>vow</sub>	NO- LIGHT[a]	ALIGN- RIGHT	DEP- IO <sub>CONS</sub>	IDENT- IO[Place]
a. mu.la j.			*!		
b. mu.lə ʔi. <Plc>			*!	*	*
c.  mu.la ʔi.				*	

It is important to note that the occurrence of glottal stop at the stem-suffix boundary is triggered by the high ranked ONSET (126). Although the failed candidate (171a) avoids the ONSET violation via cross morphemic syllabification, it fatally disobeys ALIGN-RIGHT. Candidate (171b) undergoes Debuccalisation, and thus it incurs a fatal violation of ALIGN-RIGHT as well, because the feature content of the stem, particularly the feature [Place] does not have a correspondent in the output (i.e. not faithfully parsed). Candidate (171c) is featurally faithful, eschewing any violation of IDENT-IO[Place] and more importantly ALIGN-RIGHT, and therefore it emerges as the optimal candidate.

Now we turn to the interaction between V-Debuccalisation and r-Deletion word finally. As was shown in (89), when /r/ is deleted, the preceding low vowel gets lengthened and not debuccalised. For instance, the input form /tukar/ 'to change' surfaces as [tuka:] and not \*[tukə:]. According to Teoh (1994), the long vowel [a:] fails to undergo Debuccalisation (i.e. Teoh's vowel reduction rule) because its structural description does not meet the rule. The low vowel is now multiply attached to two X-slots, and not one as formalised in the rule. This is in compliance with Hayes's (1986a) Linking Constraint, which states that association lines present in rules must be interpreted exhaustively. Alternatively because the long [a:] constitutes a heavy syllable, it is not subject to the constraint NO-LIGHT[a]. Therefore, NO-LIGHT[a] is vacuously satisfied. If V-Debuccalisation were to apply, it would crucially violate IDENT-IO[Place]. Although this constraint is lower ranked, it determines the winner between the two competing candidates, as the following tableau shows.

## (172) The interaction between V-Debuccalisation and r-Deletion

/bakar/	ALIGN- RHOTIC	NO- LIGHT [a]	ALIGN- RIGHT	MAX- IO <sub>x</sub>	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. ba.kar .	*!					
b. ba.ka.< >		*!	*	*	*	
c.  ba.ka:< >			*		*	
d. bakə:< >  <Plc>			*		*	*!

The ruled out candidate (172b) contains a light syllable [a] word finally, and therefore it fatally violates NO-LIGHT[a]. Candidates (172c) and (172d) spares NO-LIGHT[a] because their final syllables are heavy. They both violate ALIGN-RIGHT and MAX-IO<sub>CONS</sub>, and satisfy MAX-IO<sub>x</sub> equally. Thus, they tie with each other, the next available constraint IDENT-IO[Place], which plays a decisive role here, selecting (172c) as the optimal output.

### 3.5 Conclusion

The phonology of suffixation demonstrates that the prosody-morphology interface alignment constraint ALIGN-RIGHT, which requires that the right edge of a stem coincide with the right edge of a syllable, plays a significant role in the phonology of Malay at the stem-suffix juncture. ALIGN-RIGHT prohibits cross-junctural syllabification. This explains why the satisfaction of ONSET by tautosyllabic parsing is generally blocked in this environment.

In order to satisfy ALIGN-RIGHT and ONSET simultaneously, the stem-final segment undergoes ambiskeletal parsing, which is construed here as the parsing of the root node of the stem to two X-skeletal (timing units), which are then immediately dominated by two successive syllables. Following Itô and Mester (1994), ALIGN-RIGHT is interpreted as 'noncrisp', a doubly-linked structure not being reckoned as an alignment violation. This straightforwardly explains the phenomena of V-gemination and C-gemination. In the case where ambiskeletal parsing is impossible, the ONSET requirement is fulfilled by Glottal Epenthesis (see §3.2.1).

ALIGN-RIGHT also interacts with the CODA COND constraints ALIGN-STOP(K), ALIGN-RHOTIC and ALIGN-NASAL as the result of morpheme concatenation. CODA COND constraints are formalised here in terms of the alignment statement of Itô and Mester (1994), requiring particular consonants be left-aligned with a syllable. Although ALIGN-STOP(K), ALIGN-RHOTIC and ALIGN-NASAL belong to the same family, they are distinct, and therefore separately ranked in the hierarchy (see §3.5).

These constraints are also distinguishable with respect to Itô and Mester's (1994) notion of 'crispness' alignment. ALIGN-STOP(K) is interpreted as 'crisp' alignment, which requires a sharp edge alignment, while ALIGN-RHOTIC and ALIGN-NASAL are 'noncrisp' alignment constraints.

# 4

## *The phonology-morphology interface in prefixation*

---

### 4.1 Introduction

After investigating the phonological aspects of suffixation, we now turn to prefixation.<sup>1</sup> It is apparent that the morphophonological behaviour of prefixation in this language is quite distinct both in character and degree of generality from suffixation. Processes that are visibly active at the stem-suffix juncture are generally not active at the prefix-stem boundary, and vice versa. This asymmetry has not been satisfactorily accounted for in previous works.

In the previous chapter, we observed that the stem-suffix juncture acts as a barrier, blocking cross-junctural syllabification, Nasal Assimilation, and Nasal Coalescence. Formally, this is due to the high ranking ALIGN-RIGHT, a prosody-morphology interface constraint requiring the right edge of a stem to coincide with the right edge of a syllable. ALIGN-RIGHT is construed here as ‘noncrisp’, where a multiple-linking structure is not counted as an alignment violation, and thus it does not block cross-junctural ambisekeletal parsing.

However, as we shall see in the following discussion, a reverse state of affairs occurs in the domain of prefixation. Another alignment constraint of the prosody-morphology interface at work here is ALIGN-PREF, requiring that the right edge of a prefix must coincide with the right edge of a syllable. ALIGN-PREF is a dominated constraint, and therefore it is violated whenever a conflict arises.

In the process of prefixation, the concatenation of stems with prefixes forces ALIGN-PREF to interact with the structural constraints ONSET, CODA COND, \*NÇ and OCP. The interaction between ALIGN-PREF and ONSET is explored in §4.2. The conspiracy to satisfy ONSET triggers the processes of Glottal Epenthesis and cross-junctural syllabification.

Sections 4.3 and 4.6 examine the cases where ALIGN-PREF has to be violated in order to secure the satisfaction of the CODA COND constraints ALIGN-NASAL and ALIGN-RHOTIC.

---

<sup>1</sup> Other morphological processes are circumfixation and infixation. Although morphologically and semantically distinct, phonologically circumfixes are composed of two formatives, namely a prefix and a suffix, which can both occur independently in a word. The phonological behaviour of circumfixes is similar to that of the independently occurring prefix and suffix, and therefore they can be analysed as a combination of prefix plus suffix. Infixation is morphologically not distinct from ordinary prefixation. The usual alignment of an external affix can be minimally violated with the affix displaced inward under compulsion of higher ranked constraints (cf. McCarthy & Prince 1993b). In this study I assume that there are only two affixational morphologies in Malay, namely, prefixation and suffixation.

These are manifested in the phenomena of cross-junctural Nasal Assimilation, Nasal Deletion and r-Deletion. The violation of ALIGN-PREF is also compelled by the satisfaction of the OCP and \*NÇ. The OCP and \*NÇ effects are demonstrated in the processes of Nasal Deletion and Nasal Coalescence, and they are discussed in §4.4 and §4.5, respectively.

#### 4.2 ONSET satisfaction: Glottal Epenthesis and Resyllabification

As demonstrated in §2.4, while ONSET is highly ranked, the language disfavours onsetless surface syllables, it is violated in two instances, namely, at word initial and root medial positions. The violation of ONSET is compelled as to secure the satisfaction of two undominated constraints in the hierarchy, ALIGN-LEFT (50) and ROOTCONTIG (63), which apparently share some common phonological targets: ALIGN-LEFT bans word-initial epenthesis and deletion, and ROOTCONTIG prohibits root-internal epenthesis and deletion.

When V-final prefixes combine with V-initial stems, the derived underlying vowel sequence /V+V/ cannot be syllabified heterosyllabically as [V.V], as this incurs a fatal violation of ONSET. Both constraints ALIGN-LEFT and ROOTCONTIG are ineffective here, because the onsetless syllable now occurs word internally, and at the edge of the root. Compliance with the ONSET requirement is then achieved by Glottal Epenthesis. The satisfaction of ONSET compels a violation of a faithfulness constraint DEP-IO<sub>CONS</sub>, since the epenthetic glottal stop does not have any correspondence in the input. By contrast, in combination with C-final prefixes, the onsetless stem readily gets its onset from the preceding consonant via the Minimal Onset Satisfaction Principle (Roca 1994).

##### (173) a. V-final prefixes + V-initial stems

/di+asah/	[diʔasah]	'to sharpen (passive)'
/di+olah/	[diʔolah]	'to beguile (passive)'
/di+elak/	[diʔelaʔ]	'to avoid (passive)'
/di+iŋat/	[diʔiŋāt]	'to remember (passive)'
/di+ubah/	[diʔubah]	'to shift (passive)'
/dʒuru+atʃara/	[dʒuruʔatʃarə]	'master of ceremonies'
/dʒuru+ukor/	[dʒuruʔuko:]	'surveyor'
/sə+utoh/	[səʔutoh]	'to be as intact as'
/sə+iras/	[səʔiras]	'to be as similar as'
/sə+aman/	[səʔamān]	'to be as peaceful as'
/kə+iŋen+an/	[kəʔiŋənnān]	'desire'
/kə+əmas+an/	[kəʔəməssan]	'golden'
/kə+ada+an/	[kəʔadaʔan]	'situation'

##### b. C-final prefixes + V-initial stems

/bər+asah/	[bərasah]	'be sharpen'
/bər+ubah/	[bərubah]	'change (stative)'
/pər+ubah+an/	[pərubahhan]	'a state of change'
/tər+aŋkat/	[təraŋkat]	'to carry (passive)'
/məŋ+aŋkat/	[məŋaŋkat]	'to carry (active)'
/məŋ+asah/	[məŋāsah]	'to sharpen (active)'
/pəŋ+aŋkat/	[pəŋaŋkat]	'carrier (an instrument)'
/pəŋ+asah/	[pəŋāsah]	'sharpen (an instrument)'



Notice that in (173a) the post- and prevocalic high vowels are not parsed tautosyllabically (e.g. \*[səwtoh], \*[səjras], etc.) or ambiskeletal (e.g. \*[dijasah], \*[dʒuruwatʃarə], etc.) to eschew the ONSET violation without incurring DEP-IO<sub>CONS</sub> violation. This suggests that there is a barrier at the prefix-stem juncture blocking cross-morphemic syllabification. As can be seen in (173b), this is not true, because cross-morphemic syllabification at the prefix boundary is permitted.

As was demonstrated in §3.2.1, the satisfaction of ONSET by means of Glottal Epenthesis is visibly active at the stem-suffix boundary. Although it is possible to have tautosyllabic parsing escaping both ONSET and DEP-IO<sub>CONS</sub> violations, this is not an optimal solution in the suffixed words. Syllabification across stem-suffix juncture is not permitted due to ALIGN-RIGHT. As noted, this prosody-morphology interface constraint requires that the right edge of the stem must coincide with the corresponding right edge of a syllable. Glottal Epenthesis is the only way where the coincidence between the edge of the stem and the edge of a syllable can be obtained.

Following the same line of reasoning, the phonology of prefixation needs a similar type of formal constraint from the GENERALISED ALIGNMENT constraint family, which demands that the edge of some grammatical category coincide with the corresponding edge of some prosodic category. The relevant constraint at play here is ALIGN-PREF, which can be formally defined as follows:

(174) ALIGN-PREF

Align (Prefix, Right, σ, Right)

Constraint (174) resembles ALIGN-RIGHT (77), which states that the right edge of a prefix must coincide with the right edge of a syllable. Observe how, in the following examples, Glottal Epenthesis guarantees coincidence between the edge of the prefix and the edge of a syllable, whereas tautosyllabification locates the morphological prefix-edge inside a syllable. The relevant prefix-edge is marked by ' | ' and the syllable boundary is shown by a full stop ' . '.

(175) Prefix-Syllable Alignment.

Input: /sə+utoh/      Output: a. [sə|ʔu.toh.]  
b. \*[sə|w.toh.]

In order for ALIGN-PREF to be fully satisfied, the final segment of the prefix must be parsed at the right edge of a syllable. If tautosyllabification were to apply, the right edge of the prefix would lie inside a syllable. This causes a misalignment of the leading edges of the syllable and the prefix.

As far as constraint ranking is concerned, obviously DEP-IO<sub>CONS</sub> must be dominated by ONSET and ALIGN-PREF. The effects of this ranking are illustrated in the tableau below.

(176) Glottal Epenthesis across prefix boundary

/sə+utoh/	ONSET	ALIGN-PREF	DEP-IO <sub>CONS</sub>
a. sə u.toh	*!		
b. sə w.toh		*!	
c. ʔ sə ʔu.toh			*

The failed candidate (176b) undergoes cross-morphemic tautosyllabification, which locates the stem-edge inside a syllable, a fatal violation of ALIGN-PREF. Although candidate (176a) is well-aligned, it disobeys ONSET, and therefore it is fatal as well. The optimal candidate (176c) spares both ALIGN-PREF and ONSET, at the expense of violating the lower ranked DEP-IO<sub>CONS</sub>. Notice that the optimal candidate (176c) does not violate the undominated constraint ROOTCONTIG (63), since C-epenthesis takes place at the root edge and not root internally.

Another potential candidate that needs to be considered is \*[sə].wu.toh.]. This candidate obeys ALIGN-PREF and ONSET, respectively. The emergence of [w] in the above form is the result of ambiskeletal parsing of the high vowel /u/. As was shown in (31) above, ambiskeletal parsing incurs a violation of INTEGRITY-X, but this violation cannot rule out the suboptimal output \*[sə].wu.toh.] because INTEGRITY-X is ranked lower than DEP-IO<sub>CONS</sub> in the hierarchy.

The elimination of \*[sə].wu.toh.] must, therefore, be a function of other constraints. It is common cross-linguistically that an ambiskeletal parsing (i.e. feature spreading in the rule-based analysis) must only be allowed to go rightward, crossing syllable boundaries, due to a widely observed constraint against ONSET-NUCLEUS HOMORGANICITY (Keer 1995; Thornburn 1995; McCarthy & Prince 1995b). The high ranking of this constraint certainly rules out the suboptimal candidate \*[sə].wu.toh.].

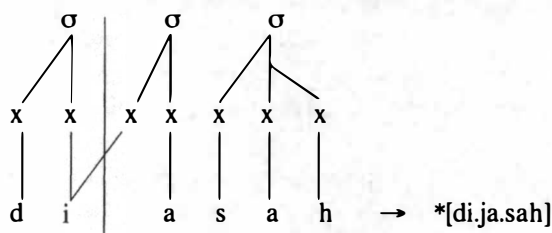
Observe that in (173a) cross-junctural ambiskeletal parsing is also prohibited at the prefix boundary. Significantly, ONSET-NUCLEUS HOMORGANICITY is not effected here, since the association is going rightward, crossing the syllable boundary. This prohibition, therefore, must be due to ALIGN-PREF, which functions as a barrier blocking cross-morphemic syllabification.

Recall that in the process of suffixation the conspiracy to satisfy ONSET and ALIGN-RIGHT forces the stem-final segment being parsed ambiskeletally across stem-suffix juncture, giving rise to V-geminate and C-geminate (see §3.2.1 and §3.2.2). Following Itô and Mester (1994), ALIGN-RIGHT is construed as a 'noncrisp' alignment constraint, where a multiple linking structure in ambiskeletal parsing is not reckoned as an alignment violation.

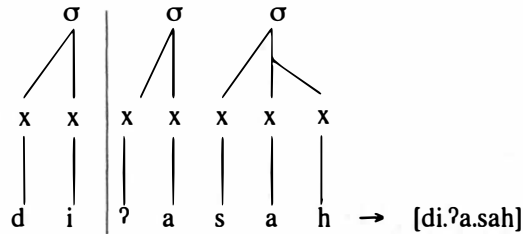
However, a reverse state of affairs occurs in prefixation. Candidates with multiple-linked structures such as \*[məŋŋasah] and \*[dijasah] never emerge as the optimal outputs. This suggests that ALIGN-PREF must be construed as 'crisp', requiring a single linking representation. As suggested in Itô and Mester (1994), both 'crisp' and 'noncrisp' alignment constraints are independently required in OT.

The constraint ALIGN-PREF is closely parallel to ALIGN-RIGHT in Axininca Campa (McCarthy & Prince 1993a:39), which demands sharply defined morpheme edges. Multiple linking, as in (177), undoes the desired relation between the morphological and prosodic constituency of a form.

(177) Ambiskeletal parsing with multiple linking — ALIGN-PREF violation



(178) Glottal Epenthesis — ALIGN-PREF satisfaction



In short, the disparity between prefixation and suffixation arises as a result of satisfying two prosody-morphology interface constraints, ALIGN-RIGHT and ALIGN-PREF, distinguished on the requirement of crispness satisfaction. To account for Glottal Epenthesis in (173a), I propose the following partial constraint hierarchy: ONSET >> ALIGN-PREF >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X, \*M/H. This ranking correctly gives the desired result, as demonstrated in the tableaux below, where a multiple-linked structure is signalled by ‘V’:

(179) Glottal Epenthesis is preferred to ambiskeletal parsing

/di+asah/	ONSET	ALIGN-PREF	DEP-IO <sub>CONS</sub>	INTEGRITY-X	*M/H
a. di asah	*!				
b. dj a.sah.		*!			*
c. di ja.sah V		*!		*	*
d.  di ʔa.sah			*		

(180) Glottal Epenthesis is preferred to tautosyllabic parsing

/sə+utoh/	ONSET	ALIGN-PREF	DEP-IO <sub>CONS</sub>	INTEGRITY-X	*M/H
a. sə u.toh	*!				
b. sə w.toh		*!			*
c.  sə ʔu.toh			*		

Cross-junctural ambiskeletal parsing and tautosyllabification force the prefix-edge to lie inside a syllable, and this fatally violates ALIGN-PREF, as shown in candidates (179c) and (180b). The only way to guarantee a sharp coincidence between the edge of the prefix and the edge of a syllable is by Glottal Epenthesis, as in candidates (179d) and (180c).

Another possibility of ensuring the satisfaction of ONSET and ALIGN-PREF is by deleting the initial vowel of the stem (e.g. \*[di|sah] or \*[sə|toh]). The price paid for such a strategy is a violation of MAX-IO<sub>vow</sub>. As noted, MAX-IO<sub>vow</sub> is an unviolated constraint in the language, given the fact that a vowel can never be deleted when it conflicts with the structural wellformedness constraint.

We now turn to the process of prefixation involving a concatenation between C-final prefix and V-initial stems. Notice that in (173b), the onsetless stem readily gets its onset from the preceding consonant, in compliance with the Minimal Onset Satisfaction Principle

(Roca 1994). The satisfaction of ONSET by cross-morphemic syllabification certainly violates ALIGN-PREF. Therefore, given the hierarchical ranking developed above, C-resyllabification across the prefix boundary can never be more harmonic than the one with Glottal Epenthesis, as the following tableau shows:

(181) C-resyllabification across prefix-stem boundary — incorrect result

/məŋ+asah/	ONSET	ALIGN-PREF	DEP-IO <sub>CONS</sub>
a. məŋ a.sah	*!		
b. ☺ mə.ŋ a.sah.		*!	
c. ☹ *məŋ .ʔa.sah			*
/bər+asah/			
a. bər a.sah	*!		
b. ☺ bə.r a.sah		*!	
c. ☹ bər .ʔa.sah			*

As can be seen, the evaluation procedure has chosen the suboptimal candidates (181c) as the optimal output. Since this is not the actual surface output, this suggests that the candidate in hand must be violating some other dominant constraint in the language, which brings about its elimination. It is quite obvious that the dismissal of candidates (181c) is connected with the occurrence of the segments [ŋ] and [r] in the syllable coda.

As already mentioned, although Malay syllables may have a coda, there is a constraint in the language whose ranking bans a small class of segments from occupying the coda position, and this constraint is the syllable structure constraint family CODA COND. I have suggested that Malay requires a set of micro constraints subsumed under the CODA COND constraint family, namely, ALIGN-STOP(K), ALIGN-RHOTIC and ALIGN-NASAL. For the purposes of this section, we focus on the last two constraints, since they are the ones relevant to the present discussion.

There are only five C-final prefixes in Malay, namely, /məŋ-/ , /pəŋ-/ , /bər-/ , /tər-/ and /pər-/ . These prefixes end either with /r/ or /ŋ/ , and therefore they are subject to ALIGN-NASAL (101), which penalises any occurrence of specified CPlace nasal in the coda, and ALIGN-RHOTIC that bans any occurrence of rhotic /r/.

As noted, ALIGN-NASAL and ALIGN-RHOTIC are distinct constraints, and therefore they are ranked separately in the hierarchy. As shown in §2.5, ALIGN-RHOTIC is ranked above ALIGN-RIGHT, while ALIGN-NASAL is dominated by ALIGN-RIGHT.

Considering the case under discussion, both ALIGN-NASAL and ALIGN-RHOTIC must be ranked above ALIGN-PREF, so that their satisfaction takes priority whenever a conflict arises. Recall that the need to satisfy ALIGN-NASAL (or ALIGN-RHOTIC) and ALIGN-RIGHT forces the stem-final nasal to undergo ambiskeletal parsing, giving rise to a nasal-geminate (or r-geminate). A double-linked structure in a geminate is not counted as a violation of ALIGN-NASAL (or ALIGN-RHOTIC) and ALIGN-RIGHT, because both constraints are ‘noncrisp’.

However, a nasal-geminate or r-geminate at the prefix boundary will fare no better than cross-junctural syllabification, since they also violate ALIGN-PREF. Cross-junctural syllabification is more harmonic because it is more faithful to the input than a nasal or a r-geminate, which compels a violation of INTEGRITY-X. The tableau in (182) gives a clear picture of the points I just made.



As I have argued earlier, however, Teoh's analysis misses one important phonological generalisation, that is, the fact that the occurrence of a glottal stop in this language is nondistinctive and highly predictable. Postulating the glottal stop as underlying increases the number of phonemes in the inventory, and therefore the phonemic inventory becomes less economic. Furthermore, in order to capture the simple regular process of cross-morphemic syllabification at the prefix-stem juncture, motivated by Minimal Onset Satisfaction (Roca 1994), Teoh (1994) needs two rules, that are moreover extrinsically ordered. The first rule must obligatorily delete a glottal stop in the stems, while the second rule resyllabifies the C-final prefix in the following onsetless syllable. Obviously, such an analysis causes complexity in the grammar, and therefore it should be discarded.

In addition, it is observed that the so-called underlying glottal stop occurs in this specific location and never in any other word positions. When this restrictional distribution is taken into account, then the phonemicity of the glottal stop becomes precarious and suspicious. The occurrence of a glottal stop in other environments, such as in the coda and in the onset at the suffix boundary is not lexical, but rule-derived via Debuccalisation (§2.5.1) and Glottal Epenthesis (§3.2.1), respectively.

In contrast to Teoh, I affirm that V-initial stems begin with vowel segments. This means that Malay basic syllable structure can be onsetless (cf. Farid 1980; Yunus 1980). The occurrence of a glottal stop in the intervocalic position at the prefix juncture is construed as a result of epenthesis, phonologically motivated as a resolving mechanism for breaking up the hiatus (cf. Farid 1980; Durand 1987; McCarthy & Prince 1993b).

In McCarthy and Prince's (1993b) analysis of stem-initial hiatus in Malay/Indonesian, they proposed a solution based on constraint reranking (cf. Cohn & McCarthy 1994). It is not an unusual strategy within the OT framework that morphophonological differences between prefixation and suffixation in a language are accounted for by assuming that the two morphological processes are governed by two separate but interconnected constraint systems, namely, prefix-level and suffix-level, which are distinguished by constraint reranking. For instance, in their analysis of Axininca Campa, McCarthy and Prince (1993a) employ constraint reranking to capture phonological distinctions between prefixation and suffixation.

It has long been observed that the phonological properties of prefixation and suffixation are quite distinct both in character and in degree of generality in many languages. Therefore, in many phonological theories and analyses, they are treated differently in the grammar.

In standard Lexical Phonology (Kiparsky 1982; Mohanan 1982), it is claimed that the word formation rules (WFRs) and the lexical phonological rules can be partitioned into a series of levels or strata. The ordered lexical strata function as the domains of application for these morphological and phonological rules. Thus, within this framework, phonological differences between prefixation and suffixation can be captured by postulating that each morphological process operates at a different stratum in the grammar.

In Prosodic Phonology, particularly in the theory of the Prosodic Hierarchy (Nespor & Vogel 1986), it is argued that the level of the word, defined prosodically rather than morphologically, is a significant level for the application of phonological rules. The relevant prosodic constituents which constitute rule domains are the syllable, the foot, and the prosodic word.

By adopting the Prosodic Hierarchy (Nespor & Vogel 1986), it can be granted that prefixation and suffixation constitutes a different prosodic domains. As argued by Cohn (1989), in Hungarian and Indonesian, a combination of stem and suffix forms a Prosodic Word which constitutes a domain for the application of phonological rules. However, such a prosodic domain is not formed when the stem combines with a prefix.



In the OT framework, the morphophonological distinction between prefixation and suffixation can be accounted for by positing two different constraint systems in the grammar. As McCarthy and Prince (1993a:24) state:

In terms of a standard Lexical Phonology of the grammar, it is plausible to assume that there are distinct Prefix-level and Suffix-level constraint systems ... Each level constitutes a separate mini-phonology, just as in ordinary rule-based Lexical Phonology (e.g., Kiparsky 1982, Mohanan 1982, Borowsky 1986) or in the level-based rule + constraint system of Goldsmith (1990, 1991). The constraint hierarchies at each level will overlap only in part, and will in fact specify somewhat different constraint rankings. Each level selects the candidate form that best satisfies its parochial constraint hierarchy ...

To come back to the case of stem-initial hiatus in Malay/Indonesian, McCarthy and Prince (1993b) propose constraint reranking ONSET >> ALIGN-LEFT (cf. Cohn & McCarthy 1994). It is important to note that in their analysis ALIGN-LEFT is formally defined as Align (Stem, L, PrWd, L) (50), which says that the left edge of the stem must coincide with the left edge of a Prosodic Word. Since PrWd dominates  $\sigma$  in the Prosodic Hierarchy, the stem edge cannot lie within a syllable, if ALIGN-LEFT is to be satisfied.

In McCarthy and Prince's (1993b) analysis, ALIGN-LEFT requires sharply-defined morphological and prosodic edges (i.e. a 'crisp' alignment in Itô and Mester's (1994) terms), and an ambisyllabic linkage at the prefix boundary (i.e. ambiskeletal parsing in this study) is counted as violating ALIGN-LEFT. Given this assumption, the competing candidates \*[di].[a.sah] and [di].[a.sah] both violate ALIGN-LEFT equally. The choice is then decided by ALIGN-LEFT, which is evaluated gradiently, rather than categorically. [di].[a.sah] is preferred to \*[di].[a.sah], because the former violates ALIGN-LEFT less seriously than the latter. As McCarthy and Prince (1993) state:

The worse violation separates the left stem-edge from the syllable-edge (and therefore the PrWd-edge) by a full segment, and moreover a segment that is sponsored by a morpheme outside the stem. The better violation mis-aligns by only the empty segment  $\square$ , realised as a glottal stop.

The interaction between ONSET and ALIGN-LEFT in the prefix-level constraint system is demonstrated in the tableau below.

(184) Glottal Epenthesis in /V+V/ cluster: ONSET >>ALIGN-LEFT

/di+asah/	ONSET	ALIGN-LEFT
a. di[.a.sah	*!	
b. di[j]a.sah		j!
c. $\text{☞}$ di[.□]a.sah		□

In candidate (184a), the stem-edge ' | ' aligns with a PrWd-edge ' [ '. Although the candidate is well-aligned, it fatally disobeys ONSET. By contrast, in candidates (184b) and (184c), the stem-edge ' | ' lies inside a syllable, thus ALIGN-LEFT is violated. At this stage ALIGN-LEFT is evaluated gradiently rather than categorically. Minimal violation of ALIGN-LEFT is accessed based on the segment. The element  $\square$  is a feature-geometric Root node with no dependents; the consonant [j] has a Root node, plus the various dependent features that make up an [j] (cf. McCarthy & Prince 1993b). This means that  $\square$  is contained within [j], so by minimal violation, (184c) violates ALIGN-LEFT less seriously than (184b) does.



In sum, in McCarthy and Prince's (1993) analysis the phenomenon of Glottal Epenthesis at the prefix boundary is accounted for by the reranking of ONSET >> ALIGN-LEFT. The violation of ALIGN-LEFT is evaluated gradiently, based on the featural makeup of the segment. The glottal stop makes a better candidate because it is an empty element with no featural dependent. Given the facts of Malay, this analysis works well with V-final prefixes, but yields an undesired result with C-final prefixes as the following tableau demonstrates.

(185) Glottal Epenthesis in /C+V/: ONSET >> ALIGN-LEFT — incorrect result

/məŋ+asah/	ONSET	ALIGN-LEFT
a. məŋ [.]a.sah	*!	
b. ☺ mə[ŋ]a.sah		ŋ!
c. ☹ *məŋ [.]a.sah		□

As in (184) above, by a gradient violation of ALIGN-LEFT, the evaluation will go for candidate (185c). However, this is an incorrect result, because the actual output form is (185b) as indicated by '☺'. If other relevant constraints are to be considered, obviously candidate (185b) is superior because it spares the highly ranked CODA COND constraint ALIGN-NASAL and the faithfulness constraint DEP-IO<sub>CONS</sub> as well.

In sum, the constraint-reranking approach proposed in McCarthy and Prince (1993b) is unsatisfactory because it can only account for Glottal Epenthesis in (184), failing to capture the regularity of cross-junctural syllabification at the prefix-stem boundary in (185).

#### 4.3 ALIGN-NASAL satisfaction: Nasal Assimilation and Nasal Deletion

As mentioned, all C-final prefixes in Malay end either with /r/ or /ŋ/. Neither segment can occur in the coda position, as they are ruled out by the CODA COND constraints ALIGN-RHOTIC and ALIGN-NASAL, respectively. By contrast, ALIGN-PREF requires that these segments must be in the coda, so that they are well-aligned with the syllable edge. This shows that the two constraints are in a conflict situation, the satisfaction of one constraint leading to the violation of the other.

In what follows, I shall first examine the interaction between ALIGN-NASAL and ALIGN-PREF. The interaction between ALIGN-RHOTIC and ALIGN-PREF will be pursued in §4.6.

Malay has two final-nasal prefixes, namely, the active voice marker /məŋ-/ and the derived nominal formative /pəŋ-/. Essentially, both forms exhibit the same phonological behaviour. The final nasal segment undergoes phonological alternations as follows:

- (186) a. /məŋ+ikat/ [məŋɪkat] 'tie'  
           /məŋ+ubah/ [məŋubah] 'change'  
           /məŋ+olah/ [məŋɔlah] 'compose'  
           /məŋ+elak/ [məŋɛlaʔ] 'avoid'  
           /məŋ+aŋkat/ [məŋaŋkat] 'lift'
- b. /məŋ+basoh/ [məmbasoh] 'wash'  
           /məŋ+datan/ [məndatan] 'come'  
           /məŋ+gali/ [məŋgali] 'dig'  
           /məŋ+tfuba/ [məŋtʃubə] 'try'  
           /məŋ+dzilāt/ [məŋdzilat] 'lick'

c.	/məŋ+uaŋi/	[məwãŋi]	'fragrance'
	/məŋ+uarna+i/	[məwãrnã?i]	'colour'
	/məŋ+iaken+kan/	[məjãkenkan]	'convince'
	/məŋ+iuran+i/	[məjũrannĩ]	'fees'
d.	/məŋ+masak/	[məməsa?]	'cook'
	/məŋ+nanti/	[məñnãnti]	'wait'
	/məŋ+ŋaŋi/	[məjŋaŋi]	'sing'
	/məŋ+ŋaŋa/	[məjŋãŋã]	'agape'
	/məŋ+lompat/	[məlompat]	'jump'
	/məŋ+rompak/	[mərompa?]	'rob'
e.	/məŋ+pukol/	[məmũkol]	'hit'
	/məŋ+tiru/	[məñĩru]	'copy'
	/məŋ+kutep/	[məjũtẽp]	'pick'
	/məŋ+sapu/	[məjnapu]	'wipe'

The phonological facts displayed above can be summarised as follows: (i) the nasal segment is maintained and resyllabified to the following vowels passing across the prefix boundary, (186a), (ii) the nasal assimilates to the place of articulation of a following voiced stop and affricate (186b), (iii) the nasal is deleted if preceded by non-syllabic high vowels (186c) and sonorant consonants (186d), and (iv) the nasal coalesces with the following voiceless obstruents (except for /tʃ/) yielding a homorganic nasal consonant (186e).

As can be seen, none of the forms in (186) obeys ALIGN-PREF, which requires the right edge of the prefix to coincide with the right edge of a syllable. Cross-junctural resyllabification, Nasal Deletion and Nasal Coalescence will always locate the morphological prefix-edge inside a syllable. Even Nasal Assimilation with multiply linked structure does not satisfy ALIGN-PREF, because it is a 'crisp' alignment constraint, which requires sharply defined morpheme edges.

However, all the forms in (186) are indeed in agreement with ALIGN-NASAL. The satisfaction of ALIGN-NASAL is essential because it is more dominant than ALIGN-PREF. The case of cross-junctural syllabification (186a) that effects V-initial stems has been explored in great detail in the previous section. Now, we turn to the process of Nasal Assimilation (186b).

As mentioned, it is common crosslinguistically that Nasal Assimilation is a general strategy to avoid the violation of ALIGN-NASAL (101), which penalises any occurrence of a nasal for specified CPlace in the coda. It is well accepted that place-linked homorganic nasal clusters do not violate this CODA COND constraint. This is in accord with the notion of 'noncrisp' alignment in Itô and Mester (1994).

We have seen in §3.3.3 that Nasal Assimilation never applies across a stem-suffix boundary, an instance of an ALIGN-NASAL violation. Nasal Assimilation is avoided in this environment as a consequence of respecting a more dominant constraint in the hierarchy, ALIGN-RIGHT. The violation of ALIGN-NASAL is compelled in order to secure the satisfaction of ALIGN-RIGHT.

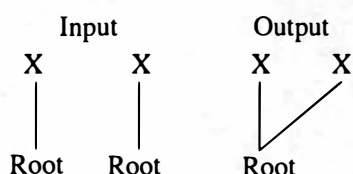
Another important generalisation in the suffix domain is that it permits cross-junctural ambiskeletal parsing, creating a geminate across the stem-suffix boundary. Ambiskeletal parsing is triggered by the conspiracy to satisfy ALIGN-RIGHT and ONSET. The price for such a parsing is a violation of INTEGRITY-X, which militates against a multiple-linked representation.

A reverse state of affairs occurs at the prefix-stem boundary, where Nasal Assimilation is operative in eschewing the ALIGN-NASAL violation. Cross-junctural ambiskeletal parsing is blocked, and therefore no geminates surface in the prefixed forms.

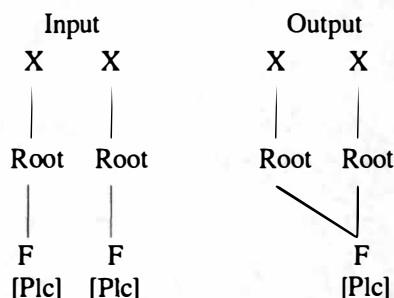
As has been noted, both geminates and place-linked clusters are not counted as a violation of ALIGN-NASAL (see §3.3.3). They do, however, violate ALIGN-PREF equally, since their position is not 'crisp'. We have also noticed that geminate clusters disobey INTEGRITY-X as the result of multiple association (see §3.3.3).

An important question that arises here is — does a place-linked cluster in partial assimilation incur a violation of INTEGRITY-X as well? The answer is definitely no, as the following representations illustrate.

(187) INTEGRITY-X violation in total assimilation



(188) INTEGRITY-X satisfaction in partial assimilation



As can be seen, total assimilation in a geminate (187) disobeys INTEGRITY-X, since the root node is doubly-linked to two X-skeletal positions. By contrast, in place-linked clusters (188), the X-skeletal is singly associated to the root node, and therefore it spares INTEGRITY-X. Although INTEGRITY-X is not affected, the process of partial assimilation incurs a violation of featural faithfulness, since it involves a delinking of the input features. The relevant formal constraint that is affected here is IDENT-IO[Place] (74), which requires that the correspondent of the input segment specified as [Place] must be [Place].

Similarly to ALIGN-RIGHT, delinking of features would result in a violation of ALIGN-PREF just as delinking of a root node (e.g. segment deletion) does. In order for ALIGN-PREF to be fully satisfied, all the feature content of the prefix, as well as the root node, must have a correspondent in the output (i.e. be faithfully parsed) (cf. McCarthy 1993b; Lombardi 1995).

Other possibilities of eschewing the ALIGN-NASAL violation are by C-deletion and V-epenthesis. The former is visibly active in the language, as we shall see shortly, but not the latter. In the previous §4.2, it was demonstrated that when faithfulness constraints conflict with the structural wellformedness constraints, the conflict is resolved by segmental insertion rather than deletion. As mentioned, the generalisation that can be deduced from here is that the deletion/insertion of a vowel and the deletion/insertion of a consonant have a very different status in Malay. This is common crosslinguistically, vowels usually behaving quite differently from consonants.

In OT, this distinction is captured by positing two different and related constraints of DEP-IO and MAX-IO, namely MAX-IO<sub>VOW</sub>/MAX-IO<sub>CONS</sub> and DEP-IO<sub>VOW</sub>/DEP-IO<sub>CONS</sub>. These constraints resemble PARSE<sup>CONSONANT</sup>/PARSE<sup>VOWEL</sup> and FILL<sup>CONSONANT</sup> and FILL<sup>VOWEL</sup> in standard OT (Prince & Smolensky 1993). Constraints of these two types are distinct, and in essence they are separately rankable in the hierarchy. Given the facts of Malay, it is evident that vowel faithfulness constraints are always more dominant than their consonant counterparts.

Considering all the constraints discussed above, the relevant ranking can be established as follows: DEP-IO<sub>VOW</sub> >> ALIGN-NASAL >> ALIGN-PREF >> INTEGRITY-X >> MAX-IO<sub>CONS</sub> >> IDENT-IO[Place].

(189) Nasal Assimilation across prefix-stem juncture

/məŋ+basoh/	DEP- IO <sub>VOW</sub>	ALIGN- NASAL	ALIGN- PREF	INTEG- RITY-X	MAX- IO <sub>CONS</sub>	IDENT- IO[Place]
a. məŋ .ba.soh		*!				
b. mə.ŋ ə.ba.soh	*!		*			
c. məŋ .ŋa.soh V			*	*!	*	
d. mə.< > .ba.soh			*		*!	
e. ʔ məm .ba.soh <Plc>			*			*

Now let us return to the pattern displayed in (185c). Notice that the stems here are also V-initial underlyingly, but in this particular case cross-junctural syllabification does not apply as expected, and what we get is the deletion of the nasal segment instead.

As demonstrated in (182), cross-junctural syllabification is triggered by ONSET satisfaction. If the same strategy were to apply here, this would only provide the first vowel with an onset. The second vowel remains onsetless, and this incurs a serious ONSET violation.

Generally, the common strategy to resolve prevocalic high vowel clusters in Malay is by ambiskeletal parsing, that is, by parsing the high vowel in the nucleus of the first syllable and in the onset of the following one. This option is preferred to V-deletion (i.e. MAX-IO<sub>VOW</sub> violation) or C-epenthesis (i.e. DEP-IO<sub>CONS</sub> violation), as it does not involve any violation of the faithfulness constraints. Furthermore, V-deletion and C-epenthesis root internally are never permitted, due to the undominated ROOTCONTIG.

As noted, the price for ambiskeletal parsing is a violation of INTEGRITY-X, which militates against multiple-X correspondences. Despite the fact that this strategy is visibly active within the root stem and across suffix boundary, it is not the preferred solution at the prefix-stem juncture. The optimal way of achieving the simultaneous satisfactions of ALIGN-NASAL and ONSET is by deleting the prefix final-nasal segment<sup>2</sup> and parsing the high vocoid in the syllable onset. The consequence of C-deletion and marginal parsing of high vowel are violations of MAX-IO<sub>CONS</sub> and \*M/H respectively.

<sup>2</sup> It must be noted that the deletion of a segment in the prefix is not accompanied by compensatory lengthening. See §4.6 for details.

As shown in (189), INTEGRITY-X dominates MAX-IO<sub>CONS</sub> in the ranking. This directly explains why Nasal Deletion is preferred to ambiskeletal parsing. The ranking relevant to the process of Nasal Deletion is as follows: ALIGN-NASAL, ONSET >> ALIGN-PREF >> DEP-IO<sub>CONS</sub> >> INTEGRITY-X, \*M/H >> MAX-IO<sub>CONS</sub>.

(190) C-resyllabification across prefix-stem boundary

/məŋ+uaŋi/	ALIGN- NASAL, ONSET	ALIGN- PREF	DEP- IO <sub>CONS</sub>	INTEG- RITY-X	*M/H	MAX- IO <sub>CONS</sub>
a. məŋ wa.ŋi	ALIGN- NASAL*!				*	
b. mə.ŋ u.a.ŋi	ONSET *!					
c. mə.ŋ u.wa.ŋi		*		*!	*	
d. mə.ŋ u.?a.ŋi		*	*!			
e. məŋ .ŋu.?a.ŋi V		*	*!	*		
f. ☞ mə.< > .wa.ŋi		*			*	*

#### 4.4 OCP effects: Nasal Deletion

It is important to note that although (186c) and (186d)<sup>3</sup> undergo the same process of Nasal Deletion, the motivation is different. In §4.3 above, I demonstrated that Nasal Deletion is the most harmonic way to eschew the ALIGN-NASAL violation. The process of Nasal Assimilation which involves a spreading of a [Cplace] feature from the following consonant, cannot take place in (186c), because the following segment is a vowel specified with a [Vplace] feature.

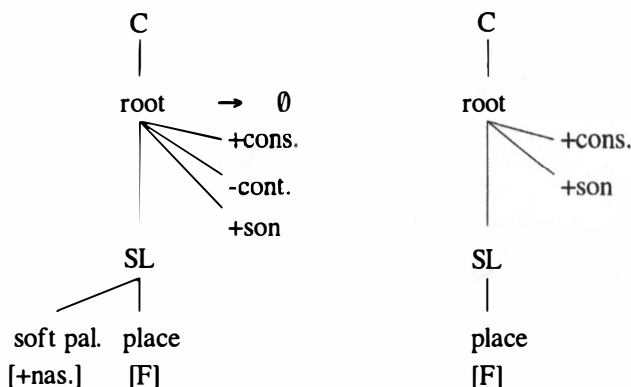
Unlike (186c), Nasal Assimilation can apply in (186d), since its structural description is fully met. Nasal Deletion can never better Nasal Assimilation given the sub-ranking MAX-IO<sub>CONS</sub> >> IDENT-IO[Place]. It is apparent that the processes of Nasal Deletion in (186d) are not the consequence of ALIGN-NASAL, but of other constraints. Before I identify this constraint, let us see how this alternation is captured in the previous rule-based approach.

The process of Nasal Deletion in Malay is captured in Teoh (1994) as the deletion of the root node of a nasal segment and everything it dominates when a [+son] consonant follows.<sup>4</sup> This rule is formalised in (191).

<sup>3</sup> There are a few words where Nasal Deletion does not apply, such as /pəŋ+lihat+an/ 'visual' and /pəŋ+libat+an/ 'involvement' which are realised as [pəŋlihatan] and [pəŋlibatan] respectively. However, in concatenation with the prefix /məŋ-/, the rule applies, and the outputs are [məlihat] and [məlibatkan]. I will therefore treat this irregularity as an exception to the regular rule.

<sup>4</sup> It must be noted that the deletion of the nasal segment in the prefix is not accompanied by compensatory lengthening. See §4.6 for details.

(191) Nasal Deletion rule as deletion of the root node of nasal (Teoh 1994:97)



In Teoh's analysis rule (191) captures the deletion of the nasal segment in both (186c) and (186d). As I commented in the preceding chapter, this is the situation where Teoh (1994) regards the non-syllabic high vowels in [waŋi] and [jaken] as lexical 'glides' (i.e. /waŋi/ and /jaken/), and therefore as part of the Malay phoneme inventory. In his distinctive feature matrix, the segments /w/ and /j/ are specified as [+high, -syllabic, +consonantal] (Teoh 1994:53). Since /w/ and /j/ are [+consonantal] segments, rule (191) can apply in (186c), as its structural description is fully met.

This analysis, however, contradicts Teoh's (1994:29) primary claim that '... /i/ and /j/ as well as /u/ and /w/ do not differ in their feature structure. The distinction between high vowel and glide will be a function of syllable structure. A [+high, -cons] segment in onset will be interpreted as a glide while the same feature in the syllable nucleus is realised as a high vowel.'

In short, as far as Malay high vowels and 'glides' are concerned, Teoh's proposal with respect to their phonological status is not consistent. At one point he affirms that they are underlyingly the same segments, but in another occasion he treats them as two different phonemes.

Rule (191), according to Teoh (1994:97), '... is natural in Malay as the phonotactics of the language in general do not allow sonorant clusters even across a morpheme boundary'. This claim is superfluous, given the fact that there are many instances where sonorant clusters do exist in the language, specifically in root internal position. These include combinations of nasal-liquid, liquid-nasal and liquid-liquid as exemplified in (192).

(192)	/loŋlai/	[loŋlaɟ]	'gracefully'
	/boŋlai/	[boŋlaɟ]	' <i>zingiber cassumunar</i> (a kind of plant)'
	/paŋlima/	[paŋlimã]	'admiral'
	/dʒumlah/	[dʒumlah]	'total'
	/pərnah/	[pərnah]	'ever'
	/pərmai/	[pərmãɟ]	'beautiful'
	/pərlu/	[pərlu]	'necessary'
	/pərli/	[pərli]	'tease'

Under the rule-based analysis, in order to account for the forms in (192), the rule of Nasal Deletion which is interpreted as a cyclic rule, is subject to the Strict Cycle Condition (SCC) (Mascaró 1976). The SCC forbids the application of cyclic rules in a non-derived environment.

As noted in §4.3, I construe the processes of Nasal Deletion in (186d), not as due to ALIGN-NASAL, but as the effect of other constraints. It is apparent that the deletion of a sonorant consonant before another sonorant consonant must be driven by the OCP (Leben 1973; Goldsmith 1976; McCarthy 1986, 1988; Mester 1986; Itô & Mester 1986; Yip 1988), which captures the generalisation that adjacent segments eschew similarity.

McCarthy (1986) suggests that the OCP operates not only as a morpheme structure constraint but also as an output condition in the course of the derivation. In particular, if the application of a rule would result in an OCP violation, the rule is blocked from taking place. In addition to rule-blocking, the OCP also triggers rule applications in the derivation.

It has been suggested in Yip (1989) and Padgett (1994) that the OCP may need to be 'dispersed', or broken down into several components in order to account for certain primary/secondary feature, root-adjacent/non-adjacent asymmetries. For instance, in his analysis of Dissimilation in Sundanese, Holton (1995) employs an OCP constraint characterised as follows: OCP([-lateral]) — Adjacent identical [-lateral] features are prohibited. This OCP constraint disallows the presence of two [-lateral] features at any distance within the same word, in the absence of an intervening [+lateral].

In the case under discussion the relevant OCP constraint at play here can be characterised as in (193) below.

(193) OCP([+sonorant, +consonantal])


Adjacent identical [+sonorant, +consonantal] features are prohibited.

Following Schein and Steriade (1986) and McCarthy (1988), I assume that the major class features [+sonorant] and [+consonantal] are directly assigned to the root node, predicting that they can never spread or delink as a class independently of the root node as a whole.

Generally, in any case where an OCP violation arises in a language, there are two possible strategies to fix things up, namely, C-deletion and V-epenthesis. The first option involves delinking the root node in one of the two identical matrices. The price for this is a violation of MAX-IO<sub>CONS</sub>. The second option inserts a default vowel to break up the clusters, and this incurs a DEP-IO<sub>VOW</sub> violation. C-deletion is used to resolve an OCP violation in Seri (Marlett & Stemberger 1983), while V-epenthesis is employed in English (Yip 1988).

In the case of Malay, C-deletion establishes a better option than V-epenthesis, given the fact that vowel faithfulness constraints are more dominant than their consonant counterparts in the hierarchy. With respect to the interaction between OCP and ALIGN-PREF, the relevant ranking is OCP >> ALIGN-PREF.

(194) Nasal Deletion at the prefix boundary

/məŋ+lompat/	DEP- IO <sub>VOW</sub>	OCP	ALIGN- PREF	MAX- IO <sub>CONS</sub>
a. məŋ.lom.pat		*!		
b. məŋə.lom.pat	*!		*	
c.  mə.lom.pat			*	*

Notice that the OCP conflict is resolved by deleting the final consonant of the prefix, as shown in the optimal form (194c). Instead of omitting the prefix final-C, it would also be possible to delete the initial consonant of the stem. In this case both ALIGN-PREF and MAX-IO<sub>CONS</sub> are violated equally. McCarthy and Prince (1995b) offer a solution to a situation like



this by suggesting that roots are more faithful than affixes, and this is governed by a general ranking schema in which root-specific versions of faithfulness constraints are intrinsically ranked higher than the general or the affix-specific version of the same constraint. In the case at hand, *ROOT MAX-IO<sub>CONS</sub>* must be ranked higher than *AFFIXMAX-IO<sub>CONS</sub>*.


It must be mentioned that there are two other common strategies for resolving an OCP violation in a language, viz. Dissimilation (Cantonese — Yip 1988, Sundanese — Holton 1995) and Total Assimilation (Berber — Guerssel 1978, Yip 1988).

Dissimilation is simply the association of a segment to different feature values in Input and Output (Yip 1988; Holton 1995). Any process of Dissimilation violates the featural faithfulness constraint *IDENT-IO(F)*, which requires that the correspondent of the input segment specified as [F] must be [F]. In the Malay case at hand, if Dissimilation were to apply, an underlying [+sonorant] must be replaced by [-sonorant] (i.e. /məŋ+lompat/ becomes \*[məklompat]). This violates *IDENT-IO[Son]*. Since this option is not optimal, *IDENT-IO[Son]* must be highly ranked in the hierarchy.<sup>5</sup>

Total Assimilation involves delinking of a root node in one of the segments, followed by spreading of the adjacent segment to the empty slot, giving rise to gemination (i.e. /məŋ+lompat/ becomes \*[məllompat]). Root node delinking violates *MAX-IO<sub>CONS</sub>* and spreading disobeys *INTEGRITY-X*. In such a situation, Total Assimilation can never be better than Nasal Deletion, which incurs only a *MAX-IO<sub>CONS</sub>* violation.

Considering these two possibilities, the interaction between the constraints discussed above is illustrated in the following tableau.

(195) Nasal Deletion at the prefix boundary

/məŋ+lompat/	DEP-IO <sub>vow</sub> , IDENT-IO[Son]	OCP	ALIGN- PREF	INTEG RITY-X	MAX- IO <sub>CONS</sub>
a. məŋ.lom.pat		*!			
b. mək.lom.pat	IDENT-IO[Son] *!		*		
c. məl.lom.pat			*	*!	*
d. mə.ŋə.lom.pat	DEP-IO <sub>vow</sub> *!		*		
e.  mə.lom.pat			*		*


Let us now move to the case where sonorant clusters are preserved root internally, in violation of the OCP [+consonantal, +sonorant]. This indicates that there must be a more dominant constraint that has to be obeyed at the expense of violating the OCP.

Recall that the prohibition of root-internal epenthesis and deletion is governed by the root-specific version of the contiguity constraint called *ROOTCONTIG*. This constraint is undominated, and therefore it is unviolated in the hierarchy. We have observed that many visibly active processes which are triggered by the higher ranked constraints are inoperative within the root domain. For instance, the satisfaction of *ONSET* by Glottal Epenthesis, and the satisfaction of *ALIGN-RHOTIC* by r-Deletion are blocked root-internally. The violations of *ONSET* and *ALIGN-RHOTIC* are compelled by the satisfaction of *ROOTCONTIG*.

Similarly, Nasal Deletion cannot take place root-internally in order to avoid a violation of *ROOTCONTIG*. The satisfaction of *ROOTCONTIG* compels a violation of the OCP.

<sup>5</sup> Notice that \*[məklompat] also violates the high ranked *ALIGN-STOP(K)*, which prohibits [k] to occur in the syllable coda. See §2.5.1.

(196) Preservation of nasal clusters root internally

/loŋlai/	ROOT CONTIG	OCP	MAX- IO <sub>CONS</sub>
a.  loŋ.laj		*	
b. lo.laj	*!		*
c. lo.ŋə.laj	*!		

In conclusion, the inapplicability of the regular processes of Nasal Deletion, r-Deletion and Glottal Epenthesis within the root domain is the consequence of the language specific constraint ranking, which ranks ROOTCONTIG above OCP and MAX-IO<sub>CONS</sub>. Root-internal deletion and epenthesis are prohibited by the high ranking of ROOTCONTIG.

#### 4.5 \*NÇ effects: Nasal Coalescence

The alternation in (186e) exhibits a process called Coalescence in which the manner of the prefix (i.e. [+nasal] feature) and the place of articulation of the stem are both maintained in the output. This process is quite common across languages. For instance, in Navajo ((Kari 1973), cited in Lamontagne & Rice 1995) coalescence takes place when the /d-/ prefix concatenates with a fricative-initial stem. Navajo Coalescence closely resembles the Malay case, where the manner of the prefix and the place of articulation of the stem are both maintained (e.g. /na+ii+d+xaat/ 'we look around' becomes [neiigaat]). Coalescence involving vowel sequences (i.e. umlaut) is attested in Rotuman (McCarthy 1995).

Traditionally, Nasal Coalescence in Malay is commonly referred to as Nasal Substitution, which is defined as a process of replacing the initial voiceless obstruent of the stem by a homorganic nasal. This process is common to many Western Austronesian languages (Dempwolff 1934–38) as well as in many African languages (Rosenthal 1989:50).

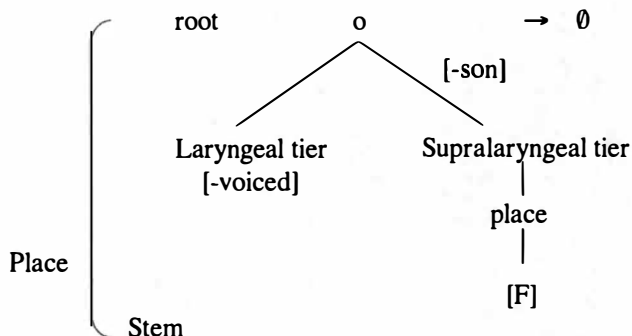
In Farid (1980) and Teoh (1994) Nasal Coalescence is treated as two separate, but related rules, which are extrinsically ordered, namely, Nasal Assimilation and Voiceless Obstruent Deletion. The rule of Voiceless Obstruent Deletion only applies at the prefix-stem juncture, and not in any other word positions. To prevent voiceless obstruents word-internally and in the suffixed forms from being deleted, the structural description of the rule has to be conditioned by the prefix or stem boundary. This explains why forms such as /sampan/ 'small boat', /pintu/ 'door', /pasan+kan/ 'to cause to be assembled' and /təgan+kan/ 'to cause to be stretched' surface as [sampan], [pintu], [pasanʔkan] and [təganʔkan], and not \*[saman], \*[pinu], \*[pasan] and \*[təgan].

(197) Voiceless Obstruent Deletion (Farid 1980:53)

$$\begin{array}{ccc} \text{C} & \rightarrow & \emptyset / \text{N} - \_\_\_ \\ [-\text{voice}] & & [\alpha \text{F}] \quad [\alpha \text{F}] \end{array}$$

Where ' - ' denotes a prefix boundary

## (198) Voiceless Obstruent Deletion (Teoh 1994:98)



According to Teoh (1994:8), 'The autosegmental rule of Voiceless Obstruent Deletion [198] says that a voiceless obstruent stem-initially with its place node multiply linked to a preceding segment [as a result of Nasal Assimilation] will be deleted at the root node'.

The formalisation in rule (198) poses a serious analytical problem. Treating assimilation as a partly linked structure (Teoh 1994:104) crucially violates the inalterability and integrity conditions (Hayes 1986a), which disallow any segment forming half of a linked structure from undergoing a phonological rule.

Before we offer an OT account of Nasal Coalescence, a few theoretical questions need to be addressed. First, why does /tʃ/ undergo Nasal Assimilation instead of Nasal Coalescence (see 186c)? This peculiar behaviour of /tʃ/ makes it difficult to capture the natural class of segments involved in those two rules. Second, why does /s/ behave like an underlying palatal instead of an alveolar? Third, why does /h/ fail to undergo Nasal Coalescence?

The original suggestion by Farid (1980:65), subsequently accepted by others (cf. Kroeger 1988; Durand 1987; Pater 1999) is that the prohibition of /tʃ/ from undergoing Nasal Coalescence is due to a transderivational constraint which serves to avoid homophony between prefixed forms of /tʃ/ — and /s/-initial stems. Supposedly, if both /tʃ/ and /s/ were to become /ɟ/, then the surface output of two distinct underlying forms would become ambiguous. This argument is not exactly legitimate because homophony is quite common in this and other languages.

As we have already seen in (139), there is homophony between the suffixed forms of the C-initial suffix /-kan/ and the V-initial suffix /-an/. For instance, forms such as /masak-an/ 'cooking, dish' and /masak-kan/ 'cook (imperative)' both surface as [masa/kan]. Homophony between the prefixed forms are also well attested in the language.

## (199) a. Homophony between /k-/ and V-initial stems

/məŋ+ukor/	[mãŋũko:]	'to measure (active)'
/məŋ+kukor/	[mãŋũko:]	'to scrape (active)'
/məŋ+urus+kan/	[mãŋũruskan]	'to cause to manage for'
/məŋ+kurus+kan/	[mãŋũruskan]	'to cause to be thin'
/məŋ+aual+kan/	[mãŋãwãlkan]	'to cause to give prior attention'
/məŋ+kaual+kan/	[mãŋãwãlkan]	'to cause to guard for'

b. Homophony between voiceless stop and nasal initial stems

/məŋ+pasak/	[māmāsaʔ]	'to push (active)'
/məŋ+masak/	[māmāsaʔ]	'to cook (active)'
/pəŋ+palu/	[pəmālu]	'one who hits'
/pəŋ+malu/	[pəmālu]	'one who is shy'
/pəŋ+tahu/	[pənāhū]	'one who knows'
/pəŋ+nahu/	[pənāhū]	'grammarian'
/pəŋ+saman/	[pəŋāmān]	'one who gives summons'
/pəŋ+ŋaman/	[pəŋāmān]	'something that comforts'

The next puzzling issue regards the behaviour of /s/ in connection with Nasal Coalescence. Under this rule, /s/ is replaced by a palatal nasal [ɲ] instead of [n]. Due to this fact, Farid (1980:5) treats /s/ as an underlying alveopalatal voiceless fricative (cf. Mester 1986). Kroeger (1988), on the other hand, suggests that /s/ is better analysed as a palatal stop /k'/ which seems to be historically a reflex of a voiceless palatal stop.<sup>6</sup> The advantage of this analysis would make Nasal Coalescence a highly natural and regular rule, as the segments affected are the voiceless stops /p, t, k', k/.

However, it is argued that this approach is excessively abstract, because it necessitates a rule of absolute neutralisation: /k'/ → [s]. In addition, it is also badly motivated, because an underlying /s/ in assimilated loan words evidently undergoes Nasal Coalescence, as seen in (200).<sup>7</sup>

(200) /məŋ+simen/	[māŋmēn]	'to cement (active)'
/məŋ+saman/	[māŋāmān]	'to summon (active)'
/məŋ+saen/	[māŋāēn]	'to sign (active)'
/məŋ+sətem/	[māŋātem]	'to put a stem (active)'
/məŋ+səkop/	[māŋākop]	'to scoop (active)'

This observation suggests that in the synchronic grammar of Malay, the phonological behaviour of patrimonial /s/ is still palatal, and therefore needs to be represented somehow.

The third and final issue regards the behaviour of /h/ with respect to Nasal Coalescence and Nasal Deletion. When h-initial stems combine with the nasal-final prefixes, both the [h] and [ŋ] segments surface in the output, as shown in the following examples:

(201) /məŋ+hantar/	[māŋhanta:]	'to send (active)'
/məŋ+halan/	[māŋhalan]	'to block (active)'
/pəŋ+habes+an/	[pəŋhabessan]	'the last'
/pəŋ+hudʒon/	[pəŋhudʒon]	'the end'

Similarly to a glottal stop, /h/ is a laryngeal consonant without a place node<sup>8</sup> (cf. Teoh 1994; Durand 1987). Therefore, it naturally cannot trigger Nasal Assimilation, and the nasal prefix remains as [ŋ]. In terms of feature specification it raises up the question whether /h/ should be classified as an obstruent or a sonorant in the phonemic inventory.

<sup>6</sup> The behaviour of /s/ as a palatal segment is manifested in all Malayo-Javanic languages (See Kroeger 1988).

<sup>7</sup> It must be mentioned that in some borrowed words which have complex onset, NS does not seem to apply, such as [mənsəpifikasikan] 'to specify' and [mənspekulasi] 'to speculate'.

<sup>8</sup> Both /h/ and /ʔ/ are transparent to Vowel Nasalisation. See §4.7 for details.

Farid (1980) and Kroeger (1988) specify /h/ as a sonorant segment. This is quite odd because h-initial stems fail to trigger the deletion of the nasal /ŋ/ in the prefix, as predicted by the Nasal Deletion rule. Teoh (1994) and Durand (1987), on the other hand, regard /h/ as a voiceless obstruent. Their analysis is also odd because the /h/ does not get omitted by the Voiceless Obstruent Deletion rule.

Durand (1987:86) offers an explanation of why the /h/ is not deleted, by invoking Farid's (1980) proposal of transderivational constraint, which serves to avoid homophony between prefixed forms. As I commented earlier, this argument is not justifiable, because homophony occurs widely in this language. I will not offer any proposal here, and leaving it for future research. This issue is beyond the scope of this study.

As mentioned, Nasal Coalescence is accounted for in Farid (1980) and Teoh (1994) by two extrinsically ordered rules, Nasal Assimilation followed by Voiceless Obstruent Deletion. Pater (1999) argues that the postulation of the Voiceless Obstruent Deletion rule is not phonologically motivated, because there is no attested case where this rule exists without Nasal Assimilation.

Furthermore, the two-ordered rule analysis also fails to account for other related homorganic cluster phenomena attested in many other languages. Therefore, this phonological alternation is better analysed as a single process called Nasal Coalescence, construed as fusion or merger of the nasal and voiceless obstruent driven by a universal and violable constraint \*NÇ, which can be formally defined as in (202).

(202) \*NÇ

No nasal/voiceless obstruent sequences

Based on language typology, it is evident that nasal-voiceless obstruent clusters are disfavoured in a wide variety of languages (Pater 1999). The generality of this \*NÇ constraint is demonstrated by the fact that Nasal Coalescence is just one range of possibilities that languages use to resolve the occurrence of nasal/voiceless obstruent clusters besides other possible solutions which include Post-nasal Voicing, Nasal Deletion and Denasalisation. Under the OT analysis, the permutation of the ranking of \*NÇ and the faithfulness constraints is all that is needed to provide a unified account of these \*NÇ effects (see Pater 1999).

Within the framework of Correspondence Theory (McCarthy & Prince 1995b), the process of merging both the nasal and the voiceless obstruent can be interpreted as a two-to-one mapping from Input to Output — two Input segments stand in correspondence with a single Output segment. The correspondence relationship between the Input and the Output, which is indicated by subscript letters, can be illustrated as below.

(203) The representation of Nasal Coalescence: e.g. /ŋ+p/ → [m]



The [m] in the output is composed of features of the two elements of the input, the nasal feature of the /ŋ/ and the place feature of the /p/. Nasal Coalescence cannot be considered to be a MAX-IO<sub>CONS</sub> violation because pieces of every element of the input are maintained in the output (cf. Lamontagne & Rice 1995). However, in the earlier version of the faithfulness constraint, particularly with the strict notion of the containment principle, this outcome does violate PARSE SEGMENT (Prince & Smolensky 1993; McCarthy & Prince 1993a).

Although Nasal Coalescence spares MAX-IO<sub>CONS</sub>, since every input segment has a correspondent in the output, it does incur violations of other constraints. Nasal Coalescence violates UNIFORMITY,<sup>9</sup> which prohibits two or more input segments from sharing an output correspondent (McCarthy & Prince 1995b; McCarthy 1995; Lamontagne & Rice 1995; Pater 1999).


(204) UNIFORMITY 'No Coalescence'

No element of the output has multiple correspondents in the input

Constraint (204) is the mirror image of INTEGRITY-X (29). The only difference is that UNIFORMITY is interpreted at the segmental level, whereas INTEGRITY-X is interpreted at the skeletal level (timing tier).


The process of Nasal Coalescence can never bring the right edge of the prefix in coincidence with the right edge of a syllable, an obvious violation of ALIGN-PREF. \*NÇ conflicts with ALIGN-PREF and UNIFORMITY, and therefore they have to be ranked with respect to each other. The ranking must be \*NÇ >> ALIGN-PREF >> UNIFORMITY, in order for a coalesced candidate to emerge as an optimal output.

(205) Nasal Coalescence: \*NÇ >> ALIGN-PREF >> UNIFORMITY

/məŋ+pukol/	*NÇ	ALIGN-PREF	UNIFORMITY
a. məm.pu.kol	*!	*	
b.  mə.mu.kol		*	*

We have seen in §4.4 that ŋ-deletion is visibly active in this language as a means of achieving structural wellformedness. This option gives another potential candidate, \*[məpukol]. This candidate spares \*NÇ and UNIFORMITY, at the expense of violating MAX-IO<sub>CONS</sub>. In order to rule out \*[məpukol], MAX-IO<sub>CONS</sub> must be ranked higher than UNIFORMITY in the hierarchy. Resolving \*NÇ by V-epenthesis can never be a better option, since DEP-IO<sub>VOW</sub> is highly ranked in the language.

(206) Nasal Coalescence: DEP-IO<sub>VOW</sub> >> \*NÇ >> ALIGN-PREF >> MAX-IO<sub>CONS</sub> >> UNIFORMITY

/məŋ+pukol/	DEP-IO <sub>VOW</sub>	*NÇ	ALIGN-PREF	MAX-IO <sub>CONS</sub>	UNIFORMITY
a. məm.pu.kol		*!			
b. mə.pu.kol			*	*!	
c. məŋə.pu.kol	*!		*		
c.  mə.mu.kol			*		*

Another way of eschewing the \*NÇ violation is by Total Assimilation. As noted, this process involves delinking a root node of one segment followed by spreading an adjacent segment to the empty slot, giving rise to gemination (i.e. /məŋ+pukol/ becomes [məppukol]).

<sup>9</sup> In his analysis, Pater (1999) employs a LINEARITY constraint instead of UNIFORMITY. According to McCarthy and Prince (1995b), the former is adopted to rule out metathesis, whereas the latter bans coalescence. In Lamontagne and Rice's (1995) analysis of Navajo Coalescence, they use a constraint called \*MULTIPLE CORRESPONDENCE (\*MC).

Root node delinking violates MAX-IO<sub>CONS</sub>, and spreading disobeys INTEGRITY-X. In such a situation, Total Assimilation fares no better than  $\eta$ -deletion.

Thus far I have only considered the possibility of eschewing the violation of \*NÇ by segmental alternation (i.e. Coalescence, Total Assimilation and  $\eta$ -Deletion). This involves a violation of segmental faithfulness constraints like MAX-IO<sub>CONS</sub> and UNIFORMITY. As demonstrated earlier, structural constraints, such as the family of CODA COND constraints, can also be satisfied via feature changing mechanisms (i.e. linking and delinking of features), and these strategies effect the featural faithfulness constraint IDENT-IO[F], which requires that the correspondent of the input segment specified as [F] must be [F].

When feature-changing mechanisms are taken into consideration, there are other possible candidates that can be generated by GEN. One potential strategy involves Post-Nasal Voicing, which produces a candidate \*[mambukol],<sup>10</sup> with a homorganic nasal-obstruent, which constitutes a licit cluster in the language. It survives \*NÇ because the obstruent is voiced.

At the featural level, the merger of two segments involves changes in the featural makeup of the segments, and thus IDENT-IO[F] is inevitably effected. Considering the candidates that undergo Post-Nasal Voicing and Nasal Coalescence, it is crucial to determine what is the relevant feature specification that distinguishes between these two forms. To get a better picture, let us compare the effects of Nasal Coalescence and Post-Nasal Voicing.<sup>11</sup>

(207) The representation of Nasal Coalescence: e.g. / $\eta$ +p/  $\rightarrow$  [m]



(208) The representation of Post-Nasal Voicing: e.g. / $\eta$ +p/  $\rightarrow$  [mb]



Both Nasal Coalescence (207) and Post-Nasal Voicing (208) satisfy IDENT-IO[NASAL] and violate IDENT-IO[VOICE] to the same degree. The voiceless input obstruent in (207) and (208) stands in correspondence with the voiced output segments nasal and stop respectively. Based on the constraints discussed thus far, (207) can never be optimal, because it incurs a violation of UNIFORMITY, whereas (208) doesn't.

As far as the feature [Voice] is concerned, Pater (1999) points out that it is a misapprehension to assume that [voice] on a sonorant and an obstruent, are equivalent (see Chomsky & Halle 1968; Lombardi 1991; Rice & Avery 1989; Piggot 1992; Rice 1993, and Steriade 1995 for discussion from a variety of perspectives). To capture the non-equivalency of sonorant and obstruent [Voice] in the present context, I follow Pater (1999), and employ a constraint called IDENT[ObsVoc], which is formally defined as follows:

<sup>10</sup> This strategy is optimal in other languages, as demonstrated in Pater (1999).

<sup>11</sup> It should be stated that these diagrams do not represent autosegmental associations. The association lines employed here indicate the correspondence relationship between the Input and Output sets of segments.




(209) IDENT[ObsVoc]

Correspondent obstruents are identical in their specification for [Voice]

The specific target of constraint (209) is [voice] obstruents, and therefore there is no need to specify whether it applies I-to-O or O-to-I. Since this constraint specifically applies to obstruents in correspondence, it is not violated by Nasal Coalescence, because in this particular case the obstruent is in correspondence with a nasal. In other words, IDENT[ObsVoc] is vacuously satisfied by Nasal Coalescence. Since the Post-Nasal Voicing candidate \*[məmbukol] is suboptimal, this suggests that IDENT[ObsVoc] must be higher ranked in the hierarchy.

(210) Nasal Coalescence: DEP-IO<sub>vow</sub>, IDENT[ObsVoc], >> \*NÇ >> MAX-IO<sub>CONS</sub>  
>> UNIFORMITY

/məŋ+pukol/	DEP-IO <sub>vow</sub> , IDENT[ObsVoc]	*NÇ	ALIGN- PREF	MAX- IO <sub>CONS</sub>	UNIFOR MITY
a. məm.pu.kol		*!			
b. mə.pu.kol			*	*!	
c.  mə.mu.kol			*		*
e. məm.bu.kol	IDENT [ObsVoc]*!		*		
f. mə.ŋə.pu.kol	DEP-IO <sub>vow</sub> *!		*		

As mentioned, Nasal Coalescence never applies within the root domain. Relevant examples are displayed in (211).

(211)	/təmpat/	[təmpat]	'place'
	/əmpat/	[əmpat]	'four'
	/santan/	[santan]	'coconut milk'
	/bantu/	[bantu]	'to help'
	/dəŋki/	[dəŋki]	'envy'
	/paŋkat/	[paŋkat]	'rank'

In previous studies (Farid 1980; Teoh 1994) this irregularity is captured straightforwardly by the fact that it does not meet the structural description of the rule which is conditioned by the prefix boundary or stem boundary. In our analysis, the preservation of nasal-voiceless obstruent clusters root internally is the consequence of satisfying a more dominant constraint in the hierarchy.

The preservation of nasal-voiceless obstruent clusters in (211) offers another piece of evidence showing that the root stem is more faithful than the morphological affixes. As mentioned, this generality is captured by McCarthy and Prince (1995b) by a general ranking schema in which root-specific versions of faithfulness constraints are intrinsically ranked higher than the general or affix-specific version of the same constraint. To account for the case under discussion, the grammar of Malay requires a root-specific constraint of UNIFORMITY called ROOTUNIF, which bans root internal coalescence (see also Pater 1999).

Similarly to ROOTCONTIG, ROOTUNIF is an unviolated constraint, and therefore it is undominated in the hierarchy. Recall that ROOTCONTIG prohibits root internal deletion and epenthesis. In this case \*NÇ is violated in order to secure the satisfactions of the undominated

constraints in the language, namely ROOTCONTIG, ROOTUNIF and IDENT[ObsVoc], as tableau (212) illustrates.

(212) Nasal-Voiceless Obstruent cluster root internally

/təmpat/	ROOT CONTIG	ROOT UNIF	IDENT [ObsVoc]	*NÇ
a. tə.mat		*!		
b. tə.m.pat				*
c. tə.mə.pat	*!			
d. tə.pat	*!			
e. təm.bat			*!	

The losing candidate (212a) undergoing Nasal Coalescence is eliminated by ROOTUNIF. The failed candidates (212c) and (212d) with root internal epenthesis and deletion are ruled out by ROOTCONTIG. Candidate (212e) undergoes Post Nasal Voicing, and incurs a fatal violation of IDENT-IO[ObsVoc]. The optimal candidate (212b) spares all these violations, at the expense of violating \*NÇ.

Recall that Nasal Coalescence is also inapplicable across a stem-suffix boundary, an instance of \*NÇ violation. Similarly to Nasal assimilation, Nasal Coalescence is opaque in this environment as a consequence of obeying ALIGN-RIGHT, a more dominant constraint in the hierarchy. \*NÇ has to be sacrificed in order to secure the satisfaction of ALIGN-RIGHT.

#### 4.6 ALIGN-RHOTIC satisfaction: r-deletion without compensatory lengthening

Recall that when r-final stems occur in isolation or attach to the C-initial suffix /-kan/, the optimal way of eschewing the ALIGN-RHOTIC violation is by root node delinking (i.e. segmental deletion). When the segment /r/ is deleted, the preceding vowels will then get lengthened. The phenomenon of compensatory lengthening is accounted for in our analysis by associating the timing-slot (possibly analysed as a mora) to the preceding vowel, in compliance with the demand of the faithfulness constraint MAX-IO<sub>x</sub> (94), which requires that every X in the input must have a correspondent in the output. The satisfaction of MAX-IO<sub>x</sub> compels a violation of NLV (94), which prohibits long vowels.

However, in the case of prefixation, when r-final prefixes concatenate with C-initial stems, the deletion of the prefix /r/ is never accompanied by compensatory lengthening. This happens both in the standard dialect (cf. Farid 1980) and in the regional dialect (cf. Zaharani 1991).<sup>12</sup> The examples in (213) observe the descriptive generalisation I just made.

Malay has three prefixes that end with /r/ namely /bər-/ and /pər-/. All of them are verbal prefixes and undergo the same phonological alternations. For present purposes, I only display derived verbs that contain the intransitive prefix /bər-/ denoting possession (i.e. a state of possessing, using or wearing the objects denoted by the root nouns).

<sup>12</sup> It must be noted that in Teoh's (1994) description compensatory lengthening applies in both forms, stems as well as prefixes. He also regards r-deletion as an optional rule in Malay. I disagree with Teoh (1994), and strongly affirm that r-deletion stem and prefix finally is obligatory (cf. Asmah 1975; Yunus 1980, Farid 1980), and that compensatory lengthening only applies to the stems, and not to the prefixes (cf. Farid 1980; Zaharani 1991).

(213) Prefixation with C-initial stems

/paioŋ/	'umbrella'	[bəpajɔŋ]
/baraŋ/	'thing'	[bəbaraŋ]
/topi/	'hat'	[bətopi]
/duri/	'thorn'	[bəduri]
/kærdʒa/	'work'	[bəkærdʒə]
/saioŋ/	'vegetables'	[bəsaioŋ]
/mata/	'eye'	[bəmātə]
/laiaŋ/	'sail'	[bəlaiaŋ]
/raga/	'basket'	[bəragə]
/uadʒah/	'face'	[bəuadʒah]
/juran/	'fees'	[bəjuran]

It is obvious that the satisfaction of ALIGN-PREF can never be achieved here, due to the dominance of ALIGN-RHOTIC in the hierarchy. Although V-insertion is another possible way of satisfying ALIGN-RHOTIC, this serves no better than r-deletion, because both disobey ALIGN-PREF equally. V-insertion is less harmonic, given the ranking DEP-IO<sub>VOW</sub> >> ALIGN-RHOTIC >> ALIGN-PREF >> MAX-IO<sub>CONS</sub>.

(214) r-deletion at prefix-stem boundary

/bər+duri	DEP- IO <sub>VOW</sub>	ALIGN- RHOTIC	ALIGN- PREF	MAX- IO <sub>CONS</sub>
a. bər.du.ri		*!		
b. ☹ bə.du.ri			*	*
c. bə.rə.du.ri	*!		*	


Another important faithfulness constraint that interacts with r-deletion that should not be disregarded in the present discussion is MAX-IO<sub>x</sub>. As demonstrated in §2.5.3 and §3.3.2, MAX-IO<sub>x</sub> crucially outranks NLV in order to get the compensatory lengthening effect in the stems. The sub-ranking MAX-IO<sub>x</sub> >> NLV, as established in (99) obviously cannot be maintained here, because there is no such effect in the prefix domain ever.

(215) r-deletion and compensatory lengthening — incorrect result

/bər+duri/	MAX- IO <sub>x</sub>	NLV
a. ☹ *bə:.du.ri		*
b. ☺ bə.du.ri	*!	

As shown, the sub-optimal candidate (215a) with a long vowel has been incorrectly selected as the winner. This candidate can be ruled out if we invoke the general markedness constraint of root-affix faithfulness, which requires that the root-specific version of faithfulness constraint is intrinsically ranked higher than the general or affix-specific version of the same constraint. This reminds us of the effect of the root-specific constraints ROOTCONTIG and ROOTUNIF, discussed above. The relevant constraint at play here is ROOTMAX-IO<sub>x</sub>.

- (216) r-deletion without compensatory lengthening — correct result

/bər+duri/	ROOT MAX-IO <sub>x</sub>	NLV	MAX-IO <sub>x</sub>
a. bə:du.ri		*!	
b.  bə.du.ri			*

The failed candidate (216a) with a long vowel, is now eliminated as a consequence of violating NLV. By contrast, the optimal candidate (216b) spares NLV by not associating the timing X-slot to the preceding vowel. ROOTMAX-IO<sub>x</sub> is not violated here because the stray-erased X-slot is not part of the root, and therefore it is vacuously satisfied.

In conclusion, a large number of disparate phonological phenomena in Malay are subject to stricter faithfulness requirements within the root than elsewhere in the word. This generalisation is common across languages: the greater markedness of roots is driven by the demand to maintain more contrast between roots than between affixes. This observation leads McCarthy and Prince (1995b:364) to make two theoretical moves. First, Root-Faithfulness must be segregated from Affix-Faithfulness. Second, the ranking of these two constraints must be fixed universally under the Root-Affix Faithfulness Metaconstraint, as in (217) below.

- (217) Root-Affix Faithfulness Metaconstraint

Root-Faith >> Affix-Faith

#### 4.7 Vowel Nasalisation

Nasal vowels in Malay are non-distinctive, since they are distributionally predictable. Vowels immediately preceded by the nasal consonants /m, n, ɲ, ŋ/ are always nasalised. Nasality spreads progressively until it is blocked by an oral consonant. It penetrates through a sequence of vowels, as well as the laryngeal consonants [ʔ, h]. Furthermore, nasality spreads across affix boundaries.

- (218) a. Nasality within a morpheme

/makan/	[mākan]	'to eat'
/malam/	[mālam]	'night'
/taman/	[tamān]	'garden'
/naek/	[nāēʔ]	'to ascend'
/maot/	[māōt]	'died'
/muat/	[mūwāt]	'fit'
/niat/	[nījāt]	'intent'
/meuah/	[mēwāh]	'luxury'
/maian/	[mājāŋ]	'stalk (palm)'
/mahal/	[māhāl]	'expensive'

- b. Nasality across morpheme

/kə+sama+an/	[kəsamāʔān]	'similarity'
/kə+meuah+an/	[kəmēwāhhān]	'prosperity'
/kə+mati+an/	[kəmāti jan]	'death'
/kə+səni+an/	[kəsəniʔjān]	'art'

/məŋ+ikot/	[mãŋĩkot]	'follow (active)'
/məŋ+aiak/	[mãŋãĩã?]	'sift (active)'
/pəŋ+kawal+an/	[pãŋãĩãllan]	'guarding'
/pəŋ+kaia+an/	[pãŋãĩã?ãn]	'enrichment'
/pəŋ+seua+an/	[pãŋẽĩã?ãn]	'letting of'

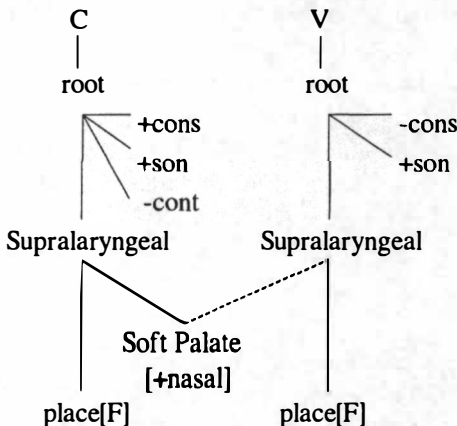
The generalisation about Malay nasality is captured in Farid (1980) by a rule called Vowel Nasalisation which is formulated as follows.

- (219) Vowel Nasalisation (Farid 1980:46)  
 [+syll] → [+nasal] / [+nasal] [-cons]<sub>0</sub> \_\_\_\_

According to Farid (1980:46), 'Rule (219), which makes use of the convention for expanding the scheme (X)<sub>0</sub>, represents a potentially infinite schema, whose various ordered subrules are each to be applied simultaneously. Thus, the application of rule (219) will result in the nasalisation of as many vowels as are separated from preceding nasals only by non-consonantal segments [w, y, h, ?]'. One notable comment about this formalism is that a non-consonantal segment is nasalised iteratively, not simultaneously. Therefore, the formalisation of the Nasalisation rule in Malay should be as follows: [-cons] → [+nasal] / [+nasal] \_\_\_\_ (cf. Zaharani 1991).

In his multilinear analysis, Teoh (1994) approaches Vowel Nasalisation as a process of spreading the soft palate node which dominates the nasal feature to the supralaryngeal node of the following vowel, and the rule is formalised as in (220). According to Teoh (1994:37), the structure of the representation in (220) is explanatorily adequate, because it can explain the process of nasalisation as the addition of another resonator, viz., the nasal cavity, which is precisely what vowel nasalisation is all about. The blocking of Vowel Nasalisation by an oral consonant can also be straightforwardly explained by the fact that these segments usually have a supralaryngeal node: this effectively blocks the spreading of the place feature of the nasal segment.

- (220) Vowel Nasalisation as Spreading (Teoh 1994).



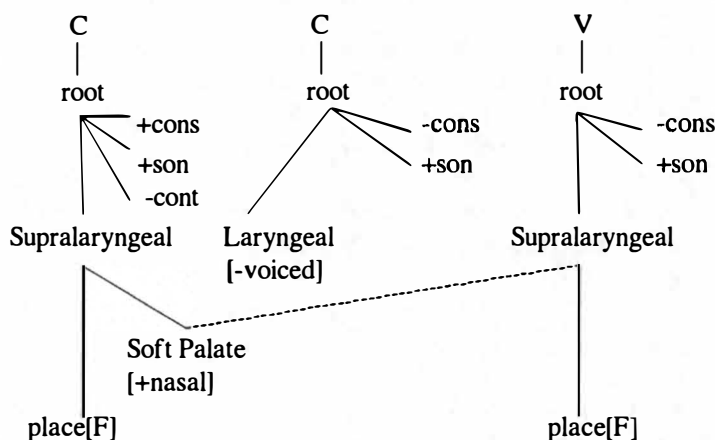
Similar to Farid (1980), Teoh (1994:39) regards the so-called 'glides' /w/ and /j/ as [-cons] segments which behave like vowels, and therefore nasality can spread across these segments, as only [+cons] segments are opaque to nasalisation. For the laryngeal glides [h] and [ʔ], this can also be explained quite straightforwardly in the multilinear analysis. These segments are

transparent with respect to Vowel Nasalisation because they are without oral closures, and therefore lack the supralaryngeal node (or articulatory gesture in Durand (1987)). As Teoh (1994:38) states,

Since /ŋ/ and /h/ lack an articulator (oral) node they can never have an oral point of articulation and thus can never be [+nasal] and so they are unspecified for nasality universally and are thus transparent to a long distance or unbounded spreading rule.

The diagram in (221) illustrates how nasalisation as autosegmental spreading of the soft palate is not blocked by the glottal stop.

(221) Vowel Nasalisation as Spreading (Teoh 1994:39).



The phenomenon of *laryngeal transparency* is quite common in a number of languages. For example, in Acoma, Nes Perce, Arbore, and Yokuts, vowels assimilate in all features to an adjacent vowel, but not to nonadjacent vowels (Steriade 1987, cited in Clements and Hume 1995). Exceptionally, laryngeal glides [h, ʔ] are transparent to this assimilation (e.g. /(ma)beh-o/ 'he is not going out' surfaces as [...boho]). According to Clements and Hume (1995:267), this behaviour can be explained on the assumption that laryngeal glides, unlike true consonants and vowels, have no distinctive oral tract features.

In the present study, Vowel Nasalisation is construed as the effect of a structural constraint  $*NV_{\text{ORAL}}$ , which militates against the sequence  $[+nasal] \widehat{[-nasal, \text{vocalic}]}$ , as formalised in (222). This constraint is employed in McCarthy and Prince (1995b), in order to account for Nasal Harmony (i.e. Vowel Nasalisation) in Madurese (cf. Mester 1986), which behaves similar to Malay.

(222)  $*NV_{\text{ORAL}}$

$*[+nasal] \widehat{[-nasal, \text{vocalic}]}$

Constraint (222) prohibits linear concatenation of segmental root-nodes with the specified properties, that is, oral vowels cannot occur at post-nasal position. One way of avoiding the  $*NV_{\text{ORAL}}$  violation is by a feature changing mechanism. In this case, the featural makeup of the vowel is changed from [oral] to [nasal]. As expected, the satisfaction of a structural constraint by a feature changing mechanism compels a violation of the featural faithfulness constraint IDENT-IO[F], which requires that the correspondent of the input segment specified as [F] must be [F].

The alternation between  $V_{\text{ORAL}}$  and  $V_{\text{NASAL}}$  in Malay is allophonic because there is no lexical contrast between the two in the surface forms. Their distribution is totally complementary, that is, nasalised vowels occur in nasal environments and oral vowels occur elsewhere. An OT account of allophonic alternation requires two segmental markedness constraints: one favours the marked member in a certain context, and another favours the unmarked alternant (McCarthy & Prince 1995b; Benua 1995). The two constraints in (223) will be used to drive the oral ~ nasal alternation.

- (223) a.  $*V_{\text{ORAL}}$  — No oral vowel  
 b.  $*V_{\text{NASAL}}$  — No nasal vowel

These two constraints are hierarchically ranked as in (224) and this ranking is universally fixed under the force of a universal markedness relation. As McCarthy and Prince (1995b) state,

Following Prince and Smolensky (1993:Ch.9), we interpret pre-theoretic ideas of featural markedness as reflecting universally fixed rankings, as in [224], of constraints against featural combinations, rather than underspecification or privativity. The universal ranking [224] entails the elementary implicational markedness observation that any language that has nasal vocoids will also have the corresponding oral vocoids.

- (224) Universal markedness relation

$$*V_{\text{NASAL}} \gg *V_{\text{ORAL}}$$

The constraints in (224) are ineffectual unless they dominate the relevant faithfulness constraint. Obviously, MAX-IO and DEP-IO are irrelevant here because the alternation does not involve any deletion or epenthesis. So, the relevant constraint at hand is a featural faithfulness constraint IDENT-IO[F], in particular IDENT-IO[Oral], which requires that the correspondent of the input segment specified as [oral] must be [oral].

Putting the constraints together, I establish the following part ranking for the hierarchy:  $*NV_{\text{ORAL}} \gg *V_{\text{NASAL}} \gg \text{IDENT-IO[Oral]} \gg *V_{\text{ORAL}}$ . The effects of this hierarchy are illustrated in tableau (225).

- (225) Vowel Nasalisation:  $*NV_{\text{ORAL}} \gg *V_{\text{NASAL}} \gg \text{IDENT-IO[Oral]} \gg *V_{\text{ORAL}}$

/kə+səni+an/	$*NV_{\text{ORAL}}$	$*V_{\text{NASAL}}$	IDENT-IO[Oral]	$*V_{\text{ORAL}}$
a. $\text{☞ kəsəni}^{\sim}\text{jān}$		**	**	**
b. $\text{kəsəni}^{\sim}\text{jan}$	*!			****

The faithful candidate (225b) incurs a fatal violation of the dominant  $*NV_{\text{ORAL}}$  constraint, because it has oral vowels in post-nasal environments. The optimal form (225a) eschews this violation at the expense of violating both the markedness constraint  $*V_{\text{NASAL}}$  and the faithfulness constraint IDENT-IO[Oral]. Since these two constraints are ranked below  $*NV_{\text{ORAL}}$ , their violation is irrelevant.

As far as feature changing mechanisms are concerned, there are of course other possibilities of avoiding the violation of  $*NV_{\text{ORAL}}$ . For instance, by changing the nasal /n/ into [t] or [d] as in  $*[\text{kəsəti}^{\sim}\text{jan}]$  and  $*[\text{kəsədi}^{\sim}\text{jan}]$ . Since these forms are not the actual surface outputs, they must be ruled out by some other relevant featural faithfulness constraints ranked higher in the hierarchy. The particular constraint that plays a crucial role here is IDENT-IO[Nasal], which requires that the correspondent of the input segment specified as [nasal] must be [nasal].



To complete the argument, other alternatives of satisfying  $*NV_{ORAL}$ , such as by segmental deletion and epenthesis are also ruled out. Besides violating MAX-IO and DEP-IO, both forms disobey the unviolated constraint ROOTCONTIG (64), which bans root-internal deletion and epenthesis. From these considerations, I infer the following constraint hierarchy: ROOTCONTIG,  $*NV_{ORAL}$ , IDENT-IO[Nasal]  $\gg$   $*V_{NASAL}$   $\gg$  IDENT-IO[Oral],  $*V_{ORAL}$ .

(226) Vowel Nasalisation

/kə+səni+an/	ROOTCONTIG, $*NV_{ORAL}$ , IDENT- IO[Nasal]	$*V_{NASAL}$	IDENT- IO[Oral]	$*V_{ORAL}$
a. $\text{ḱəsəniḱān}$		**	**	**
b. $\text{kəsənijan}$	$*NV_{ORAL}$ *!			****
c. $\text{kəsədijan}$	IDENT-IO[Nasal] *!			****
d. $\text{kəsəjan}$	ROOTCONTIG *!			***
e. $\text{kəsəntijan}$	ROOTCONTIG *!			*****

#### 4.8 Conclusion

Morpheme boundaries in Malay behave differently with respect to the phonological processes of the language. The prefix-stem boundary allows resyllabification, Nasal Assimilation, Nasal Coalescence, but prohibits ambiskeletal parsing. A reverse state of affairs occurs at the stem-suffix boundary, which permits ambiskeletal parsing, but disallows resyllabification, Nasal Assimilation and Nasal Coalescence.

This asymmetry arises due to the alignment constraints of the prosody-morphology interface, which require that the edge of some grammatical category coincide with the edge of some prosodic category. The stem-suffix boundary is controlled by ALIGN-RIGHT, requiring that the right edge of a stem coincide with the right edge of a syllable, while the prefix-stem boundary is governed by ALIGN-PREF, requiring that the right edge of a prefix coincide with the right edge of a syllable.

ALIGN-RIGHT and ALIGN-PREF are two distinct constraints, and therefore they are separately ranked in the hierarchy. In their interaction with ALIGN-NASAL and  $*N\check{C}$ , the sub-ranking goes as follows: ALIGN-RIGHT  $\gg$  ALIGN-NASAL,  $*N\check{C}$   $\gg$  ALIGN-PREF. This schematic ranking straightforwardly explains why cross-junctural Nasal Assimilation and Nasal Coalescence are transparent in the domain of prefixation, but they are opaque in the domain of suffixation.

ALIGN-RIGHT and ALIGN-PREF are also distinguishable with respect to the notion of 'crispness' in alignment of Itô and Mester (1994). ALIGN-RIGHT is interpreted as a 'noncrisp' alignment constraint, where a doubly-linked structure is not reckoned as an alignment violation, whereas ALIGN-PREF is a 'crisp' constraint requiring a sharply defined morpheme edge alignment. This explains why ambiskeletal parsing is blocked and resyllabification is permitted at the prefix boundary, while a reverse phonological behaviour is applicable at the suffix counterpart.

# 5

## *The phonology-morphology interface in reduplication*

---

### 5.1 Introduction

In Chapters 2, 3 and 4 I have presented the phonology of Malay, which includes segmental alternations and distributional restrictions. In the present chapter I examine how these phonological processes interact with another important morphological process in the language, reduplication.

As is well-known, reduplication involves identity between the base and the reduplicant. Well-behaved phonological processes are most often disrupted by the demands of reduplicative identity. The identity-preserving interactions between phonology and reduplication were generally referred to in the literature as overapplication and underapplication (Wilbur 1973a,b; Marantz 1982; Carrier-Duncan 1984; McCarthy & Prince 1995b). A phonological process is said to overapply when its application in the reduplicant or in the base is not predicted on truly phonological grounds. On the other hand, a phonological process will be said to underapply when it fails to operate in the reduplicative environment even though the environment is fully met.

A third reduplicative pattern that often emerges as the result of the phonology morphology interface in reduplication is that of normal application, when base and reduplicant are not subject to the demand of identity. In this case, the base and the reduplicant are completely well-behaved phonologically, as though they were two independent entities.

All these three reduplicative patterns are well-attested in the phonology of Malay reduplication. However, as I commented on in the first chapter, the last two reduplicative patterns, namely, underapplication and normal application, have been overlooked in the pioneering work of Farid (1980), arguably because they are very difficult, if not impossible, to account for under the rule-based approach of Wilbur's (1973a) Global Theory.

To improve on Farid's (1980) ground-breaking work, all these reduplicative patterns will be scrutinised in great detail in the present study. The analysis presented here is couched in the constraint-based approach of Correspondence Theory, set within Optimality Theory (McCarthy & Prince 1994, 1995b; McCarthy 1995). This chapter is organised as follows. Section 5.2 outlines briefly some fundamental aspects of Correspondence Theory, specifically the basic ideas and the key assumptions that underlie the architecture of the theory. Section 5.3 gives a brief overview of Malay reduplication. Section 5.4 offers a Correspondence Theoretic account of overapplication, normal application and underapplication.

## 5.2 Reduplication in Correspondence Theory

Correspondence Theory was first introduced into OT as a theory of reduplicative copying (McCarthy & Prince 1993a, 1994). Correspondence is merely a relation between the Base (abbreviated B) and the Reduplicant (abbreviated R). The relation between these two representations is controlled by a constraint family called *Reduplicative Identity Constraints*, which contains formal constraints such as MAX, BASE-DEPENDENCE, IDENTITY, LINEARITY, CONTIGUITY, and ANCHORING. Constraints of reduplicative identity demand that the reduplicant be as similar as possible to the base.

In addition to the Base-Reduplicant correlation, there is another representational relation involved in the reduplication, that is, between the Input/Stem (abbreviated I) and the Output/Base (abbreviated O). The relation between the Input/Stem and the Output/Base is governed by another family of constraints called *Faithfulness constraints*, which comprises PARSE and FILL (Prince & Smolensky 1993; McCarthy & Prince 1993a, 1994). Similarly, constraints of faithfulness demand that the output be as close as possible to the input, along all the dimensions upon which structures may vary.

In recent work by McCarthy and Prince (1995b) and McCarthy (1995), it is argued that there are parallels between these two constraint families, and that Input-Output Faithfulness and Base-Reduplicant Identity can be treated equally under Correspondence Theory. This extension leads to a generalised theory of Correspondence where the two related representations are captured and formalised as a broadly identical set of formal constraints. Constraints of the two types are distinct, and therefore separately rankable, but they come in formally related pairs, yielding identical effects in the Input-Output and Base-Reduplicant domains.<sup>1</sup> The formal definition of correspondence is given below.

(227) Correspondence (McCarthy & Prince 1995b:262)

Given two strings  $S_1$  and  $S_2$ , **correspondence** is a relation  $\mathfrak{R}$  from the elements of  $S_1$  to those of  $S_2$ . Elements  $\alpha \in S_1$  and  $\beta \in S_2$  are referred to as **correspondents** of one another when  $\alpha \mathfrak{R} \beta$ .<sup>2</sup>

Generally, there are three primary constraint families that represent the correspondence relation between the string  $S_1$  (input/base) and  $S_2$  (output/reduplicant), and they are formally defined as follows:

(228) Constraints on Correspondent Elements (McCarthy & Prince 1995b:264)

The MAX Constraint Family

General Schema — Every segment of  $S_1$  has a correspondent in  $S_2$ .

MAX-BR — Every segment of the base has a correspondent in the reduplicant. (Reduplication is total.)

MAX-IO — Every segment of the input has a correspondent in the output. (No phonological deletion).

<sup>1</sup> McCarthy and Prince (1995b) notes that Correspondence need not be limited to the Base-Reduplicant and Input-Output relations only. The same notions can be extended to relations between two stems, as in root-and-pattern, circumscriptional, or truncating morphology (cf. Benua 1995; McCarthy 1995).

<sup>2</sup> The term 'element' here refers to segments, higher-order units of prosodic structure such as moras, syllables, feet, heads of feet, tones, and also distinctive features or feature nodes (McCarthy & Prince 1995b).

### The DEP Constraint Family

General Schema — Every segment of  $S_2$  has a correspondent in  $S_1$ . ( $S_2$  is 'dependent on'  $S_1$ .)

DEP-BR — Every segment of the reduplicant has a correspondent in the base. (Prohibits fixed default segmentism in the reduplicant.)

DEP-IO — Every segment of the output has a correspondent in the input. (Prohibits phonological epenthesis).

### The IDENT (F) Constraint Family

General Schema

IDENT(F) — Let  $\alpha$  be a segment in  $S_1$  and  $\beta$  be any correspondent of  $\alpha$  in  $S_2$ . If  $\alpha$  is  $[\gamma F]$ , then  $\beta$  is  $[\gamma F]$ . (Correspondent segments are identical in feature F)

IDENT-BR(F) — Reduplicant correspondents of a base  $[\gamma F]$  segments are also  $[\gamma F]$ .

IDENT-IO(F) — Output correspondents of an input  $[\gamma F]$  segments are also  $[\gamma F]$ .

With the advent of Correspondence Theory, the constraints MAX-IO and DEP-IO respectively reformulate the earlier faithfulness constraints PARSE-segment and FILL-segment, which prohibit phonological deletion and epenthesis<sup>3</sup> in Prince and Smolensky (1993) and other OT work. Furthermore, the MAX and DEP families subsume the specific reduplicative constraints MAX and BASE-DEPENDENCE in McCarthy and Prince (1993a, 1994), which require a total copying and exact copying of the base-correspondent materials. MAX and BASE-DEPENDENCE are respectively violated in partial reduplication and in a reduplication containing fixed default segments in the reduplicant.

The IDENT constraint family demands that the correspondent segments be identical in terms of feature specifications. Violating IDENT, in particular in the input-output domain, is manifested by phonological alternations. Segmental deletion and epenthesis do not imply violations of IDENT, but of MAX and DEP. McCarthy and Prince (1995b) point out that under Correspondence Theory, the IDENT constraint family is constructed on the assumption that segments alone stand in correspondence, so featural relations must be transmitted through them.

In addition to MAX, DEP and IDENT, there are other relevant constraints on correspondence elements, such as ANCHOR, INTEGRITY and UNIFORMITY (see McCarthy & Prince 1995b). We will discuss these constraints briefly as they become relevant to the exposition.

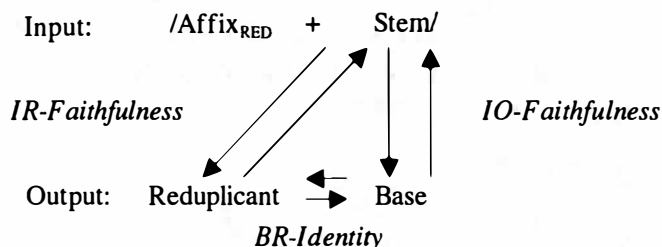
## 5.2.1 The Model

As far as reduplication is concerned, the correspondence relation between Input/Output and Base/Reduplicant can be represented in two models, namely (i) the Full Model, and (ii) the Basic Model (McCarthy & Prince 1995b; McCarthy 1995). The Full Model theory of reduplication involves three-way correspondence relations: (i) between the Stem/Input (abbreviated I) and the Base/Output (abbreviated O), (ii) between the Base (abbreviated B) and

<sup>3</sup> In the PARSE/FILL approach of OT, phonologically deleted segments are present in the output, but remain unparsed syllabically (marked by an angle bracket '< >'). This property is dubbed 'containment' in McCarthy and Prince (1993a). See also footnote 3 Chapter 2.

the Reduplicant (abbreviated R), and (iii) between the Stem/Input (I) and the Reduplicant (R). The diagram in (229) below delineates this system of relations.

(229) Full Model (McCarthy & Prince 1995b)



The *IO-Faithfulness* system evaluates the correspondence relation between the input stem and the output base; the *BR-Identity* system evaluates the correspondence relation between the base and the reduplicant; and finally the *IR-Faithfulness* system evaluates the correspondence between the reduplicant and the stem. As noted in McCarthy and Prince (1995b), the terms *Faithfulness* and *Identity* employed here emphasise the distinct dimensions along which these perfectly homologous notions are realised. *Faithfulness* and *Identity* are basically controlled by exactly the same set of formal constraints, such as MAX, DEP, IDENT, INTEGRITY, etc.

Following the principle of parallelism, which is one of the basic tenets of OT, the three correspondence systems are evaluated symmetrically and simultaneously in all the possible candidates with respect to the language's constraint hierarchy (McCarthy & Prince 1995b). This parallelism of constraint satisfaction entails that the base does not have serial priority over the reduplicant, and that the reduplicant is not essentially a copying or replication of the previously fixed base. Instead, both the base and the reduplicant can interact each other, as it were, in order to achieve the best possible satisfaction of the constraint hierarchy. The result is that, under certain circumstances, the base will also be expected to copy the reduplicant. This distinguishes the parallelist OT from the serialist theories of grammatical derivation.

Although the Full Model approach is logically possible, McCarthy and Prince (1995b) argue that the relation between the reduplicant and the input stem — via *IR Faithfulness* — is impossible for principled reasons. It is claimed that the reduplicant can never be more faithful to the input as compared to the base. This is essentially because the output reduplicant has no access to the input stem, except through the output base.

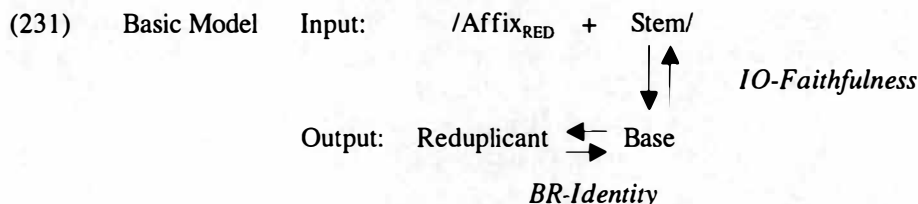
More importantly, it is a consistent finding that morphological affixes are unmarked relative to roots (McCarthy & Prince 1995b). For instance, affixes tend to have reduced segmental inventories, favouring coronal consonants and unmarked vowels; root-controlled vowel harmony is a profound case of vocalic unmarkedness in affixes; and affixes tend to avoid clusters, complex onsets, long vowels, and geminates, but roots allow them.

These observations led McCarthy and Prince (1995b:364) to make two theoretical claims. First, Root-Faithfulness must be segregated from Affix-Faithfulness. Second, the ranking of these two constraints must be fixed universally under the Root-Affix Faithfulness Metaconstraint as, in (230) below.

(230) Root-Affix Faithfulness Metaconstraint  
Root-Faith >> Affix-Faith

Since the reduplicant is regarded as a kind of affix, *IR-Faithfulness* is a typical instance of Affix-Faithfulness. On the other hand, because the base is a root or root-containing stem, *IO-Faithfulness* is a particular instance of Root-Faithfulness. Under the metaconstraint (230), which embodies a substantive universal claim about constraint domination, *IR-Faithfulness* is never allowed to dominate *IO-Faithfulness*.

Following this general principle, *IR-Faithfulness* must always occur in a subordinate position dominated by *IO-Faithfulness*, and as a result its effects are not so significant. In many rankings, its presence is completely or almost completely hidden, and therefore it is convenient to adopt the simplified version of the Full Model represented in the following diagram, known as the Basic Model (McCarthy & Prince 1995b).



For purposes of the present study I will adopt the Basic Model approach to account for the three reduplicative patterns mentioned above. Before we proceed, some analytic categories need to be clarified.

Under Correspondence Theory (McCarthy & Prince 1993a, 1994, 1995b; McCarthy 1995), the terms Reduplicant and Base refer specifically to structures present in the candidate output forms and not to characteristics of the input. The Reduplicant R, which is the output form of the affix morpheme /RED/, typically has a phonologically-unspecified lexical entry. It gets its phonological material from the Base B to which it is attached — for reduplicative prefixes, the following structure, and for reduplicative suffixes, the preceding structure.

Each candidate (i.e. R+B) comes equipped with a correspondence relation between R and B that expresses the dependency between the elements of R and those of B. It is the existence of such a correspondence relation that makes a morpheme reduplicative. As expected, each of these candidates is then subject to evaluation with respect to the language's hierarchical constraint system.

### 5.3 Malay reduplication: an overview

Generally, reduplication in Malay is categorised into two primary classes, namely, (i) Root-Reduplication — the process of copying the base root, most often in conjunction with prefixation and suffixation, and (ii) Doubling — the process of complete copying of the base stem (i.e. root + affix).

Root-Reduplication is the most productive and versatile type of reduplication in the morphology of Malay. The derived forms furnish a variety of semantic nuances which basically denote the meanings of plurality, repetition, continuity, intensity, extensiveness and reciprocity. Most interestingly, the various combinations of reduplication with suffixation and prefixation give rise to a number of significant phonological patterns. The present study will be focusing particularly on this aspect and not so much on their semantic interpretations, which will be scrutinised in §5.4.

Doubling is also widely used in the language. As mentioned, in this type of reduplication the reduplicant is completely identical to the base stem, which comprises a combination of root and affix. Doubling basically applies to nominal derived forms, denoting the meaning of plurality. Examples of such forms are as follows:

(232)	Root	Base	Doubling
	tari 'to dance'	pənāri 'dancer'	pənāri-pənāri 'dancers'
	datan 'to come'	pəndatan 'immigrant'	pəndatan-pəndatan 'immigrants'
	baŋon 'to arise'	baŋōnnān 'building'	baŋōnnan-baŋōnnān 'buildings'
	kaseh 'to love'	kəkaseh 'lover'	kəkaseh-kəkaseh 'lovers'
	satu 'one'	kəsatuwan 'union'	kəsatuwan-kəsatuwan 'unions'

In addition, there are two other secondary classes of reduplication, commonly referred to as (i) Partial Reduplication and (ii) Rhyming and Chiming. In Partial Reduplication the reduplicant is realised as a light syllable. Within the framework of templatic morphology, the prosodic structure of the reduplicative morpheme RED consists of a skeletal template CV. This template obtains its melodic content from copying the first consonant of the base root, while its rhyme is prespecified with a central vowel schwa.<sup>4</sup> Partial reduplication operates on nouns and verbs to derive nouns that denote objects or animals resembling those denoted by the base forms.

(233)	laki 'husband'	ləlaki 'man, male'
	kudā 'horse'	kəkudā 'wooden horse, pillion'
	laŋēt 'sky'	ləlaŋēt 'ceiling, palate (mouth)'
	səpət 'clip'	səsəpət 'something to clip'

As noted in Asmah (1975:190), this type of reduplication became particularly productive<sup>5</sup> after 1956 when the Dewan Bahasa dan Pustaka (Government's Language Planning Agency) revived this morphological process as a procedure for coining new words that are designed to convey scientific terms or concepts which are mainly borrowed from English.

<sup>4</sup> In previous analyses, it was suggested that the reduplicant copies the initial syllable of the base root, and then the copied vowel is reduced to schwa (see Asmah 1975; Nik Safiah 1989; Hashim 1993).

<sup>5</sup> However, it must be noted that this type of reduplication is widely used in colloquial Malay (Abdullah 1974:45) and some of the Malay dialects (Hendon 1966:59; Farid 1980:69; Zaharani 1993:70) as a simplified variant of total copying reduplication. Often, the reduplicant turns up heavy, that is, with a CVC syllabic structure. The final C in the rhyme is realised as either a homorganic nasal or a glottal stop, as determined by the final consonant of the base: the homorganic nasal surfaces when the base ends in a nasal segment, and the glottal stop when the final consonant is a stop. Examples are:

buwat	bəʔbuwat	buwat-buwat	'make, do'
gəlap	gəʔgəlap	gəlap-gəlap	'dark'
tembaʔ	təʔtembaʔ	tembaʔ-tembaʔ	'shoot'
bajaŋ	bəmbajaŋ	bajaŋ-bajaŋ	'shadow'
pətaŋ	pəmpətaŋ	pətaŋ-pətaŋ	'evening'
dəlam	dəndəlam	dəlam-dəlam	'deep'
tanām	təntanām	tanām-tanām	'bury'
kawan	kəŋkawan	kawan-kawan	'friend'

Another sub-class of partial reduplication involves copying the final syllable of the base (see Abdullah 1974:45; Farid 1980:69).

budaʔ	daʔbudaʔ	budaʔ-budaʔ	'children'
katə	təkətə	katə-katə	'speak'
hitam	tamhitam	hitam-hitam	'black'
rumāh	māhrumāh	rumāh-rumāh	'house'



(234)	səndi 'joint'	səsəndi 'rheumatism'
	tikos 'mouse'	tətikos 'mouse (in computer)'
	gəndaŋ 'drum'	gəgəndaŋ 'ear-drum'
	pədʒal 'firm'	pəpədʒal 'a solid'
	pəpəndʒuru 'corner'	pəpəndʒuru 'diagonal'
	bənāŋ 'thread'	bəbənāŋ 'filament'

Rhyming and Chiming is another type of morphological process. It involves unpredictable phonetic changes and is traditionally regarded as a kind of reduplication (Bador 1964, Abdullah 1974; Farid 1980; Nik Safiah 1989; Hashim 1993). In Rhyming reduplication, one of the base syllables, either the initial syllable (together with the following consonant) or the final syllable is copied onto the reduplicant. In Chiming, only the consonants are repeated, while the vowels undergo phonetic modifications.

(235) a. Rhyming Reduplication

anāʔ 'child'	anāʔ-pināʔ 'a large number of children'
kajə 'rich'	kajə-rajə 'very rich'
kuweh 'cake'	kuweh-mūwēh 'various kinds of cakes'
kaju 'wood, stick'	kaju-kajan 'various types of woods/plants'
batu 'stone'	batu-batan 'assortment of stones and bricks'
buket 'hill'	buket-bukaw 'various kinds of hills'

b. Chiming Reduplication

tʃutʃu 'grandchild'	tʃutʃu-tʃitʃet 'grandchildren'
gopoh 'hasty'	gopoh-gapah 'to do things hastily'
asal 'origin'	asal-usol 'ancestor'
tanāh 'soil'	tanāh-tanēh 'various kind of soils'
gunōŋ 'mountain'	gunōŋ-ganāŋ 'various kind of mountains'

Considering the examples given above, it is apparent that the phonetic modifications that take place in the reduplicant are absolutely unpredictable. Therefore, they cannot be captured and formalised into rules. Furthermore, Rhyming and Chiming are no longer productive in the language. All the forms that are classified under the so-called Rhyming and Chiming are relatively long-existing native words. There are no new words ever formed that have this morpho-phonological pattern. Following this observations, I assume that the so-called Rhyming and Chiming reduplicated forms are fully lexicalised in the language, and cannot be regarded as part of word formation.

#### 5.4 The phonology-morphology interface in Root Reduplication

As was mentioned, Root Reduplication involves total copying of the root, most often in conjunction with prefixation and suffixation. In addition to having a variety of semantic nuances, the reduplicated forms demonstrate a variety of reduplicative patterns. This latter aspect of Root Reduplication will play a significant role in the following discussion.

The patterns of Root Reduplication in Malay can be observed in table (236). The underlying root is shown in first column. Reduplication of the bare root is displayed in the second column, and affixed root reduplication is in the third column. The effects of affixation are shown by using the affixes /məŋ-/ , /di-/ , /bə-/ , /-an/, and /kan/.

## (236) Malay Root Reduplication

## a. C-initial roots

/tahan/ 'stop'	[tahan-tahan]	[ditahan-tahan] [tahan-tahankan] [mǝnǎhǎn-nǎhǎn] [tahan-mǝnǎhǎn]
/pandaŋ/ 'watch'	[pandaŋ-pandaŋ]	[bəpandaŋ-pandaŋ] [pandaŋ-pandaŋŋǎn] [dipandaŋ-pandaŋ] [məməndaŋ-māndaŋ] [pandaŋ-mǝməndaŋ]
/dua/ 'two'	[duwə-duwə]	[bəduwə-duwə] [bəduwa-duwaʔan]
/bəsar/ 'big'	[bəsa:-bəsa:]	[dibəsa:-bəsa:kan] [məmbəsa:-bəsa:kan] [bəsar-bəsarran]

## b. V-initial roots

/api/ 'fire'	[api-ʔapi]	[api-ʔapikan] [mǝŋǎpi-ŋǎpikan] [bərapī-rapi]
/alu/ 'welcome'	[alu-ʔalu]	[alu-ʔaluwan] [diʔalu-ʔalukan] [mǝŋǎlu-ŋǎlukan] [alu-mǝŋǎlu]
/ikot/ 'follow'	[ikot-ʔikot]	[ikot-ʔikottan] [diʔikot-ʔikotkan] [bərikot-rikot] [bərikot-rikottan]

As can be seen, prefixes and suffixes are generally not carried along in the reduplicant, implying that the affixes must be excluded from the reduplicative morpheme. In other words, the reduplicant only copies the root. The only exception is in the case of V-initial roots where the final-C of the prefix is copied in the reduplicant. Overcopying of prefix-final C is triggered by the structural constraint ONSET, and this will be pursued in detail in §5.4.1.5.


The ONSET requirement also drives the process of Glottal Epenthesis in reduplicated forms. Other relevant phonological processes that interact with reduplication are Nasal Coalescence, Vowel Nasalisation, r-Deletion and Vowel Debuccalisation. We shall examine each of these processes as we proceed.

It is apparent that reduplication in Malay is suffixal. A piece of evidence demonstrating that /RED/ is post-positive comes from the phonological behaviour involving the opacity of cross-junctural Nasal Assimilation and Nasal Coalescence, which are driven by the structural constraints ALIGN-NASAL and \*NÇ, respectively.<sup>6</sup>

<sup>6</sup> These two processes are very regular at the prefix boundary. See §4.3 and §4.5 for details.

As was demonstrated in §3.3.3, the opacity of Nasal Assimilation and Nasal Coalescence at the suffix boundary is governed by the phonology-morphology interface constraint ALIGN-RIGHT, which requires that the right edge of the stem must coincide with the right edge of a syllable. Obedience to ALIGN-RIGHT compels a violation of ALIGN-NASAL and \*NÇ. The subhierarchical ranking that has been established is ALIGN-RIGHT >> ALIGN-NASAL, \*NÇ. The effects of this ranking in ordinary suffixation are illustrated in the tableau below.


(237) ALIGN-RIGHT >> ALIGN-NASAL, \*NÇ

/padam+kan/	ALIGN-RIGHT	ALIGN-NASAL	*NÇ
a.  padamkan		*	*
b. padan <del>kan</del>	* !		*
c. padan <del>jan</del>	* !		

The failed candidate (237b) undergoes Nasal Assimilation. In the rule-based approach the input nasal segment loses its specified [Place] node by delinking, and a new [Place] node is obtained from the following consonant through spreading. The consequence of feature delinking is a violation of the featural faithfulness constraint IDENT-IO[Place] in (74). A more serious outcome of feature delinking is a fatal violation of ALIGN-RIGHT.

As was noted in Chapter 3, in order for ALIGN-RIGHT to be fully satisfied, all the feature content of the input stem, including the root node, must have a correspondent in the output (i.e. be faithfully parsed) (cf. McCarthy 1993b; Lombardi 1995). The coalesced candidate (237c) also fatally violates ALIGN-RIGHT. The merging of /mk/ into /ŋ/ locates the stem edge inside a syllable, and therefore the candidate in hand is ill-aligned. By treating the reduplicative morpheme RED as a suffix, this straightforwardly explains why the reduplicated form is also opaque to Nasal assimilation and Nasal Coalescence. More evidence demonstrating that /RED/ is indeed suffixal comes from the reduplicative behaviour involving overapplication (see §5.4.1) and normal application (see §5.4.2). The same constraint ranking in (237) is at work here. The interaction of ALIGN-RIGHT >> ALIGN-NASAL, \*NÇ in suffixing reduplication is illustrated in tableau (238). For convenience, the reduplicative morpheme is marked with an underline.

(238) ALIGN-RIGHT >> ALIGN-NASAL, \*NÇ

/pandan+RED/	ALIGN-RIGHT	ALIGN-NASAL	*NÇ
a.  pandan- <u>pandan</u>		**	*
b. <u>pandam-pandam</u>	* !	*	*
c. panda- <u>mandan</u>	* !	*	

Form (238b), the assimilated candidate, and form (238c), the coalesced candidate are both eliminated by ALIGN-RIGHT, as they are not faithful to the input. By contrast, the underlying segment /ŋ/ in the optimal candidate (238a) is faithfully parsed, and therefore it obeys ALIGN-RIGHT, at the expense of violating the structural constraints ALIGN-NASAL and \*NÇ.

As was commented on in the previous chapter, the opacity of Nasal Assimilation at the suffix juncture is not discussed in Teoh (1994). Farid (1980:13), on the other hand, treats this as an exception, as he notes: 'Nasals always appear on the surface as homorganic to a

following consonant, except in cases of reduplication, or if the cluster consists that of nasal plus suffix-initial consonant [kan]’.

Given an OT account, as demonstrated in tableaux (241) and (238) above, the irregular behaviour of Nasal Assimilation in the suffixed and reduplicated forms is indeed an explainable phenomenon. This regular process does not take place in the optimal output because the candidate in hand is not the candidate best satisfying the constraint hierarchy.

As noted above, prefixes and suffixes are generally not copied in the reduplicant, suggesting that affixes must be excluded from the reduplicative morpheme. The reduplicative suffix only copies the materials in the root.

This reduplicative behaviour closely resembles the pattern of root reduplication in Makassarese (McCarthy & Prince 1994) and verbal reduplication in Axininca Campa (McCarthy & Prince 1993a:Ch.5). The constraint responsible for root reduplication is R=ROOT,<sup>7</sup> which is formally defined in McCarthy and Prince (1994:26) as in (239).

(239) R=ROOT

The reduplicant is identical to the root

Constraint (239) demands that every phonological element of the reduplicant have a correspondent in the root, and, equivalently, that every element of the root have a correspondent in the reduplicant. Each element of the reduplicant that is not part of the root, or any element of the root that is not included in the reduplicant constitutes a violation of R=ROOT.

Additionally, I assume that, in order for R=ROOT to be fully satisfied, those correspondent elements must be featurally identical. Each R=ROOT violation can be reckoned separately, and the candidate with the least violations will be preferred, in accordance with the general principle of OT.

In contrast to R=ROOT, a reduplicative constraint MAX-BR demands total copying of the base (e.g. root + (affix)). MAX-BR belongs to the BR-IDENT (*BR-Identity*) constraint family, and is formalised as follows.


(240) MAX-BR

Every segment of the base has a correspondent in the reduplicant

By this constraint, the reduplicant must contain all the phonological elements of the base, namely, the root and the affix elements. Any element of the base left out constitutes a violation of MAX-BR, assessed separately.

Both R=ROOT and MAX-BR determine the segmental make up of the reduplicant. It is obvious that these two constraints conflict with each other, and therefore the satisfaction of one constraint leads to a violation of the other. This suggests that R=ROOT and MAX-BR must be ranked with respect to each other in the constraint hierarchy. In order for R=ROOT to be visibly active, it must dominate MAX-BR, as illustrated in (241).

(241) Root copying: R=ROOT >> MAX-BR

/di+pukol+RED/	R=ROOT	MAX-BR
a.  dipukol-pukol		**
b. dipukol-dipukol	** !	

<sup>7</sup> In their analysis of Axininca Campa McCarthy and Prince (1993a) formalise this constraint as R<sub>≤</sub>ROOT - The reduplicant contains only the root.

As shown, the optimal candidate (241a) contains all the elements drawn from the base, as required by MAX-BR, excluding the prefix, in agreement with the higher ranked constraint R=ROOT. Obedience to R=ROOT cannot always be maintained when other phonological constraints come into play in the interaction.

Notice in (236b) above that, when a V-initial root undergoes reduplication, a process of Glottal Epenthesis applies at the base-reduplicant juncture.<sup>8</sup> It is very clear that the insertion of an epenthetic glottal stop in that environment is forced by ONSET, as the language generally disfavours onsetless surface syllables. Word-initial syllables can remain onsetless due to the dominance of ALIGN-LEFT over ONSET.

As shown in the previous chapters, Glottal Epenthesis is the common strategy to avoid an ONSET violation in Malay. In the context of reduplication, the price for such a strategy is a violation of R=ROOT. R=ROOT bars the epenthetic glottal from the reduplicant because it is not part of the root. The crucial ranking here is ONSET >> R=ROOT.

(242) Glottal Epenthesis: ONSET >> R=ROOT

/api+RED/	ONSET	R=ROOT
a. a.pi.-a.pi	**!	
b. ʔ a.pi.-ʔa.pi	*	*

Candidate (242a) has exact identity between the base root and the reduplicant, and thus it is in agreement with R=ROOT. This exact copying creates a hiatus at the base-reduplicant juncture, and thus ONSET is violated twice. Candidate (242b) only violates ONSET once, at the expense of violating R=ROOT. Since the latter candidate incurs a minimal violation of ONSET, it is the optimal form.

Another strategy to avoid a violation of R=ROOT involves affiliating the epenthetic glottal stop to the base, instead of the reduplicant, as in [a.pi.ʔ-a.pi]. This potential candidate seems to be better than (242b), because it satisfies R=ROOT, and still violates ONSET once. However, as I shall show later, this interpretation cannot be maintained, because the candidate in hand fatally violates an undominated constraint in the language.

As mentioned in §2.4, Glottal Epenthesis never applies word-initially, because of the domination of ALIGN-LEFT over ONSET. ALIGN-LEFT demands that the left edge of the morphological word must coincide with the left edge of a syllable. Word-initial epenthesis would separate the morphological word from the beginning of a syllable, a fatal violation of ALIGN-LEFT. Following this the reduplicative morpheme /RED/ must crucially be analysed as a suffix, in order for the interaction ALIGN-LEFT >> ONSET to yield the correct result.

(243) Onsetless syllable word-initially: ALIGN-LEFT >> ONSET

/api+RED/	ALIGN-LEFT	ONSET
a. .ʔa.pi.-ʔa.pi	*!	
b. ʔa.pi.-ʔa.pi		*

<sup>8</sup> As shown in Chapter 3, the conspiracy to satisfy ONSET (as well as ALIGN-RIGHT) at the suffix boundary is generally resolved by ambiskeletal parsing. Such a parsing, however, is not applicable in reduplication. See §5.4.1.5 below for details.

By contrast, if the reduplicative affix /RED/ is prefixal, the evaluation procedure incorrectly selects a suboptimal candidate \*[?a.pi.-?a.pi] as the winner, as the following tableau illustrates.

(244) Glottal Epenthesis word-initially — incorrect result

/RED+api/	ALIGN- LEFT	ONSET
a. ☹ * <u>[?a.pi.-?a.pi]</u>		
b. ☺ <u>[a.pi.-?a.pi]</u>		*!

Both (244a) and (244b) satisfy ALIGN-LEFT, whether the initial syllable contains a syllable onset or not. ALIGN-LEFT is irrelevant to the form of the reduplicant, since all reduplicants are equally well aligned, because the underlying reduplicative morpheme is phonologically unspecified (see McCarthy & Prince 1994:27, 1993a:67). The next ranked constraint ONSET rules out the actual output [a.pi.-?a.pi], indicated by '☺', and selects the incorrect form \*[?a.pi.-?a.pi] instead.

Now let us turn to the question of whether the epenthetic glottal should be affiliated to the base (e.g. [a.pi.?a.pi]) or to the reduplicant (e.g. [a.pi.-?a.pi]). These two forms differ significantly, although they are phonetically similar. In [a.pi.?a.pi] the epenthetic element is outside the reduplicant, and therefore it serves as the last segment of the base, which has no correspondent segment in the reduplicant, a clear violation of MAX-BR.

In contrast, in [a.pi.-?a.pi] the glottal stop lies outside the base root, and thus it functions as the first segment of the reduplicant. This candidate violates R=ROOT, since the glottal stop is not part of the root. As demonstrated in (241) above, however, when R=ROOT conflicts with MAX-BR, the latter has to be sacrificed. This seemingly suggests that the ranking R=ROOT >> MAX-BR favours the glottal stop being affiliated to the base.

(245) Glottal Epenthesis: ONSET >> R=ROOT >> MAX-BR

/api+RED/	ONSET	R=ROOT	MAX-BR
a. a.pi.-a.pi	**!		
b. a.pi.-?a.pi	*	*!	
c. ☹ a.pi.?-a.pi	*		*

As I shall show shortly, this interpretation cannot be maintained, because the affiliation of the glottal stop to the base, as in candidate (245c), has serious consequences on a correspondence constraint ANCHOR, which is formally defined in (246). ALIGN-RIGHT is ineffective here because all the above candidates are well-aligned, as the right edge of the stem coincides with the right edge of a syllable.

(246) {RIGHT, LEFT}-ANCHOR( $S_1$ ,  $S_2$ ) (McCarthy & Prince 1994:8, 1995b:371)

Any element at the designated periphery of  $S_1$  (Base) has a correspondent at the designated periphery of  $S_2$  (Reduplicant).

Let *Edge* ( $X$ , { $L$ ,  $R$ }) = the element standing at the Edge =  $L$ ,  $R$  of  $X$ .

RIGHT-ANCHOR. If  $x$  = *Edge* ( $S_1$ ,  $R$ ) and  $y$  = *Edge* ( $S_2$ ,  $R$ ) then  $x$ ŀ $y$ .

LEFT-ANCHOR. Likewise, *mutatis mutandis*.

ANCHOR, as stated above, entails that correspondence preserves alignment in the following sense: (i) ANCHOR-RIGHT: the right peripheral element of Reduplicant corresponds to the right peripheral element of Base, if Reduplicant is to the right of Base (suffixing reduplication). (ii) ANCHOR-LEFT: the left peripheral element of Reduplicant corresponds to the left peripheral element of Base, if Reduplicant is to the left of Base (prefixing reduplication).

I have argued earlier that Malay reduplication is suffixal, and thus ANCHOR-RIGHT is the relevant constraint that governs the correspondence relation between the base and the reduplicant. Similarly to ALIGN-LEFT, this constraint is unviolated, and therefore it is undominated in the constraint hierarchy. Considering all the constraints discussed thus far, the relevant ranking that can be established here is ANCHOR-RIGHT, ALIGN-LEFT >> ONSET >> R=ROOT >> MAX-BR. The effects of this ranking are demonstrated in the following tableau.

(247) ANCHOR-RIGHT, ALIGN-LEFT >> ONSET >> R=ROOT >> MAX-BR

/api+RED/	ANCHOR-RIGHT	ALIGN-LEFT	ONSET	R=ROOT	MAX-BR
a. a.pi.-a.pi			***!		
b. ?a.pi.-?a.pi		*!		*	
c. a.pi.?-a.pi	*!				*
d. a.pi.-?a.pi			*	*	

Candidate (247c) is ill-anchored, since the right peripheral element of the base (i.e. the epenthetic glottal [ʔ]) does not correspond with the right peripheral element of the reduplicant. Candidate (247d), on the other hand, is well-anchored, as the right peripheral element of the base (i.e. [i]) and the right peripheral element of the reduplicant (i.e. [i]) are in correspondence. Thus, the latter candidate is more harmonic than the former, even though they are phonetically identical.

In sum, Root Reduplication in Malay involves total copying of the root stem governed by a reduplicative constraint R=ROOT. The affixes are excluded under the domination of R=ROOT over MAX-BR. The reduplicative morpheme is treated in the analysis as a suffix, and therefore it is subject to ANCHOR-RIGHT.

R=ROOT, on the other hand, is crucially violated when other phonological constraints come into play. As shown in (242), the demand for a syllable onset necessitated by ONSET compels a violation of R=ROOT. In what follows, we shall observe other regular alternations that affect the reduplicant as the result of interaction in the phonology of the language.

In the present discussion, any distributional requirements which derive from the structural constraints, such as \*NÇ (i.e. Nasal Coalescence), ALIGN-RHOTIC (i.e. r-deletion), \*NV<sub>ORAL</sub> (i.e. Vowel Nasalisation), NO-LIGHT[a] (i.e. Vowel Debuccalisation), will be perspicuously dubbed PHONO-CONS (Phonological-Constraint).

As noted in McCarthy and Prince (1995b), phonological alternations and distributional restrictions require a ranking with PHONO-CONS dominating IO-FAITH (*IO-Faithfulness*), and this defines the phonology of the language at hand. This has been discussed in detail in the previous three chapters, and therefore, for convenience, I will use IO-FAITH as a shorthand for the family of the general constraints that control any relation between the input and the output. Specific constraints of the IO-FAITH family such as MAX-IO, DEP-IO, IDENT-IO[F], etc., will only be mentioned when they become relevant to exposition.



At the same time, when BR-IDENT (*BR-Identity*) is also active, its interaction with PHONO-CONS and IO-FAITH will give rise to three types of reduplicative patterns, which are commonly dubbed overapplication, underapplication and normal application (Wilbur 1973; Marantz 1982; Carrier-Duncan 1984; McCarthy & Prince 1995b). The main focus of this chapter is to identify the relevant constraints of the BR-IDENT family, which play crucial roles in deriving the above mentioned reduplicative patterns. Each of these three patterns will be scrutinised in turn below.

### 5.4.1 Overapplication

Overapplication involves an identity-preserving interaction between phonology and reduplication. A phonological mapping is said to overapply when it introduces, in reduplicative circumstances, a disparity between the output and the lexical stem that is not expected on purely phonological criteria. To put it simply, overapplication refers to the case in which both the base and the reduplicant undergo the same phonological alternation, although the regular triggering condition is found in just one of them.

As mentioned above, in order for phonological alternations and distributional restrictions to be visibly active, PHONO-CONS must outrank IO-FAITH in the hierarchy. At the same time when BR-IDENT is also active, then the phonological effects that occur in the base may be carried over to the reduplicant, or, conversely, the similar effects may be carried over from the reduplicant to the base. This is possible because the form of both is evaluated in parallel. Indeed, even phonological alternations arising from the interaction of the base and the reduplicant may be reduplicated, because of this parallel evaluation (McCarthy & Prince 1995b).

Overapplication effects in reduplication, therefore, can be classified into three subtypes, namely (i) base to reduplicant, (ii) reduplicant to base, and (iii) interactional. All these reduplicative patterns are attested in the language, and I will discuss each of them separately.

#### 5.4.1.1 Overapplication base to reduplicant: Nasal Coalescence

This type of overapplication refers to the case where the target of PHONO-CONS is found in the base, and this phonological effect is then transmitted to the reduplicant in compliance with the BR-IDENT requirement. Before I offer an OT account of how such interaction is derived, consider the examples listed in (248) below.

(248)	Root	Reduplicated form	Expected form
	[pukol] 'hit'	[mãmũkol-mũkol]	*[mãmũkol-pukol]
	[pandai] 'clever'	[mãmāndaj-māndaj]	*[mãmāndaj-pandai]
	[tari] 'dance'	[mānāri-nāri]	*[mānāri-tari]
	[tahan] 'stop'	[mānāhān-nāhān]	*[mānāhān-tahan]
	[kutep] 'pick'	[mājũtep-ŋũtep]	*[mājũtep-kutep]
	[kumpol] 'gather'	[mājũmpol-ŋũmpol]	*[mājũmpol-kumpol]
	[sikat] 'comb'	[mājũkat-ŋũkat]	*[mājũkat-sikat]
	[suroh] 'request'	[mājũroh-ŋũroh]	*[mājũroh-suroh]

As shown in the above examples, both conjuncts undergo the process of Nasal Coalescence, although its structural description is met only by the leftmost member. As

demonstrated in §4.5, following Pater (1995), Nasal Coalescence is construed in this study as a fusion or merger of the nasal and voiceless obstruent, driven by a PHONO-CONS constraint \*NÇ, which militates against the occurrence of nasal/voiceless obstruent sequences. When the two input segments correspond to a single output segment, this effects IO-FAITH, specifically UNIFORMITY-IO — No element of the output has multiple correspondents in the input (McCarthy & Prince 1995b).

Notice that the following vowels are nasalised, and this is phonologically expected because Nasal Coalescence creates the environment for Vowel Nasalisation to apply (see §4.7). In the present discussion, I merely focus on the overapplication of Nasal Coalescence. The overapplication of Vowel Nasalisation will be discussed in detail in the following §5.4.1.3.

Overapplication of Nasal Coalescence is quite common in Austronesian languages. For instance, in Tagalog (Bloomfield 1933; Carrier-Duncan 1984) an underlying form /paŋ+putul/ 'that used for cutting' surfaces as [pamu:tul] in the affixed form, and becomes [pamumu:tul] in the reduplicated form.<sup>9</sup> In Indonesian (Cohn & McCarthy 1994; McCarthy & Prince 1995b) forms like /məŋ+potoŋ+RED/ 'cut (intens., repet.)' and /məŋ+tulis+RED/ 'write (intens., repet.)' are realised as [məmotoŋ-motoŋ] and [mənulis-nulis], respectively. Overapplication of Nasal Coalescence in Indonesian is exactly like to that in Malay data displayed in (248).

As suggested in McCarthy and Prince (1995b), the effect of overapplication can be achieved by imposing two types of general ranking hierarchies, namely (i) PHONO-CONS >> IO-FAITH >> BR-IDENT, and (ii) PHONO-CONS, BR-IDENT >> IO-FAITH. The ranking given in (i) also regulates a reduplicative pattern of normal application where both the base and the reduplicant are phonologically well-behaved, as the process applies whenever its environment is satisfied.

Nasal Coalescence (and also Vowel Nasalisation) occurs productively in Malay in cases of both overapplication and normal application. For example, a root [tahan] 'stop' is realised as [mōnāhān-nāhān] in the overapplied form, and as [tahan-mōnāhān] in the normal one (see §5.4.2). It is apparent that to account for the Malay data the general ranking PHONO-CONS >> IO-FAITH >> BR-IDENT is considerably more adequate than PHONO-CONS, BR-IDENT >> IO-FAITH, because the former can take two different reduplicative patterns involving Nasal Coalescence under a single constraint hierarchy (see §5.4.1.3).

Since Root Reduplication in Malay is total, this raises the question of which is the reduplicant and which is the base. For bare root reduplication, I have demonstrated that the reduplicant is indeed a suffix. However, in the case of affixed reduplication in (248), it is not entirely clear whether the reduplicative morpheme is suffixal or prefixal. Therefore, both possibilities must be examined.

Let us first assume that the pattern in (248) has suffixing reduplication. The underlying representation of the reduplicated form in (248) is then /məŋ+Root+RED/. The root which is adjacent to the nasal prefix becomes the primary target of PHONO-CONS (i.e. Nasal Coalescence). The satisfaction of PHONO-CONS forces a violation of IO-FAITH.

The phonological effect in the base is then transmitted to the reduplicant, in compliance with the demand of BR-IDENT. The alternation performed in the reduplicant crucially violates R=ROOT, since the correspondent segments in the root and the reduplicant are not featurally identical. In order for overapplication to be visibly active, BR-IDENT must outrank R=ROOT.

<sup>9</sup> In McCarthy and Prince's (1995) analysis, Nasal Coalescence in Tagalog overapplies, with its effects transmitted from reduplication to base.

The constraint family BR-IDENT contains a set of formal constraints, such as MAX-BR, DEP-BR, IDENT-BR, etc. These constraints are distinct, and therefore they are separately rankable in the hierarchy. As shown in (241), MAX-BR is dominated by R=ROOT, and the effect of this ranking is that affix copying is prohibited.

Under Correspondence Theory, featural identity between base and reduplicant is governed by IDENT-BR[F], which demands that the correspondent segments in the base and the reduplicant be identical for a feature [F]. In the case under discussion, the relevant feature specification at play is [nasal], and the constraint is IDENT-BR[Nasal].

(249) IDENT-BR[Nasal]

The correspondent segments in the base and the reduplicant must have identical values for the feature [nasal].

Obviously, to account for the data in (248) the featural identity constraint in (249) must be ranked above R=ROOT. The ranking of constraints relevant to overapplication of Nasal Coalescence is PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal] >> R=ROOT >> MAX-BR. The effects of this ranking are demonstrated in tableau (250) below.

(250) Overapplication of Nasal Coalescence, assuming RED as a suffix

/məŋ+tari+RED/	PHONO-CONS	IO-FAITH	IDENT-BR[Nasal]	R=ROOT	MAX-BR
a. məntari- <u>tari</u>	*!				***
b. mənari- <u>tari</u>		*	*!		**
c. ☞ mənari- <u>nari</u>		*		*	**

Form (250a), the underapplicative candidate, contains a forbidden nasal/voiceless obstruent cluster, and thus PHONO-CONS more specifically of NÇ is fatally violated here. Form (250b), the normal applicational candidate, and form (250c), the overapplicative candidate, tie on PHONO-CONS. They also tie on IO-FAITH, since Nasal Coalescence has applied. Forms (250b) and (250c), therefore, have to be distinguished by IDENT-BR[Nasal], which forces identity between the base and the reduplicant for the feature [nasal], and the victor is the latter.

We now turn to the other possibility, that Malay has prefixing reduplication, arising from an input representation /məŋ+RED+Root/. Under this representation, the primary target of PHONO-CONS is the reduplicant. Any phonological process that applies to the reduplicant has no consequence on IO-FAITH. Satisfaction of IDENT-BR[Nasal] is not effective here, since it is ranked lower than IO-FAITH. Thus, a candidate with normal application is incorrectly chosen as the optimal output, as the following tableau demonstrates.

(251) Normal application of Nasal Coalescence, assuming RED as a prefix

/məŋ+RED+tari/	PHONO-CONS	IO-FAITH	IDENT-BR[Nasal]	R=ROOT	MAX-BR
a. məntari-tari	*!				
b. ☞ *mənari-tari			*	*	
c. ☺ mənari-nari		*!		*	

It must be noted that the overapplicative candidate (251c) would emerge as the optimal output, if IO-FAITH and IDENT-BR[Nasal] were reranked as IDENT-BR[Nasal] >> IO-FAITH. This corresponds to the general ranking BR-IDENT, PHONO-CONS >> IO-FAITH, which is also a possible solution for overapplication (McCarthy & Prince 1995b). Under this proposal the constraints in (251) are ranked as follows: IDENT-BR[Nasal], PHONO-CONS >> IO-FAITH >> R=ROOT >> MAX-BR.

(252) Overapplication of Nasal Coalescence, assuming RED as a prefix

/məŋ+RED+tari/	IDENT-BR[Nasal]	PHONO-CONS	IO-FAITH	R=ROOT	MAX-BR
a. məntari-tari		*!			
b. mənari-tari	*!			*	
c. <i>mənari</i> -nari			*	*	

Although the evaluation procedure in (252) yields the correct result, I pointed out earlier that this ranking is less motivated, because it cannot account for the reduplicative pattern of normal application (see §5.4.2). For instance, in forms like [tari-mənari] and [pukol-məmukol] the process of Nasal Coalescence only applies when its phonological environment is fully met. If the identity constraint IDENT-BR[Nasal] always takes priority over IO-FAITH, a form with normal application can never be the winner: the evaluation always will favour a candidate with overapplication as an optimal output.

To sum up, the full hierarchy of constraints relevant to the overapplication of Nasal Coalescence from the base to the reduplicant in Malay is PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal] >> R=ROOT >> MAX-BR. Under this ranking, the reduplicative morpheme RED is crucially analysed as a suffix.

#### 5.4.1.2 Overapplication reduplicant to base: *r*-Deletion and Vowel Debuccalisation

In this type of overapplication exemplified by pattern in (253), the primary target of PHONO-CONS is found in the reduplicant. Therefore, R=ROOT has to be violated if PHONO-CONS is to be obeyed. When BR-IDENT is also in demand, the phonological effect is carried over to the base. As an illustration, consider the examples given in (253).<sup>10</sup>

(253)	Root	Bare form	Reduplicated form	Expected form
	/ukor/ 'measure'	[uko:]	[uko:-ʔuko:]	*[ukorruko:]
	/adzar/ 'teach'	[adza:]	[adza:-ʔadza:]	*[adzarradza:]
	/uker/ 'carve'	[uke:]	[uke:-ʔuke:]	*[ukerruke:]
	/ator/ 'arrange'	[ato:]	[ato:-ʔato:]	*[atorrato:]

As discussed in §3.3.2, Johore Malay disallows the segment /r/ from occupying the coda position<sup>11</sup> due to the CODA COND constraint ALIGN-RHOTIC, which requires that /r/ must be

<sup>10</sup> It must be noted that in Farid's (1976)[1980] transcription there are no compensatory lengthening and epenthetic glottal stop in the reduplicated forms (e.g. [uko-uko], [ato-ato]). I have altered Farid's transcription in this respect (cf. Teoh 1994). In the present discussion, the effect of compensatory lengthening will be overlooked for reasons of simplicity.

<sup>11</sup> As noted, Teoh (1994) considers the rule of *r*-deletion as optional, whereas Farid (1980) regards it as obligatory. Based on my observation, I agree with Farid in this respect.

the onset of a syllable. The optimal way of avoiding the ALIGN-RHOTIC violation is by segmental deletion.

As far as the satisfaction of ALIGN-RHOTIC is concerned, we expect the deletion of the final /r/ in the rightmost member of the reduplicated forms, that is, the reduplicant. Observe now that the segment /r/ is also deleted in the leftmost member, that is, the base, even though ALIGN-RHOTIC can be spared by ambiskeletal parsing, as predicted by the phonology of suffixation in the language.

Recall that in ordinary suffixation when r-final stems are affixed with V-initial suffixes, the r-segment surfaces as a geminate [rr] triggered by the conspiracy to satisfy ALIGN-RIGHT and ONSET simultaneously. For instance, underlying /ukor+an/ 'measurement' is realised as [u.kor.ran]. If the same strategy were to apply to suffixing reduplication, we would expect the forms with the asterisks as the optimal outputs.

It is clear that the deletion of /r/ in the base is not due to PHONO-CONS (specifically ALIGN-RHOTIC), but is the effect of other formal constraints of the identity constraint family BR-IDENT. Is it due to MAX-BR (240), which demands that every segment of the base must have a correspondent in the reduplicant? If the base were to maintain the /r/ as a geminate [rr] (e.g. \*[u.kor.ru.ko:]), this segment would not have any correspondent in the reduplicant, in obvious violation of MAX-BR. In order to eschew the MAX-BR violation, the [r] of the base has to be omitted.

The satisfaction of MAX-BR by deleting the underlying segment of the base compels a violation of IO-FAITH. This violation is not possible when the subranking is IO-FAITH >> MAX-BR. As demonstrated in tableau (241), MAX-BR is a lower-ranked constraint dominated by R=ROOT, and therefore its effects are not significant. Under the general ranking PHONO-CONS >> IO-FAITH >> R=ROOT >> MAX-BR established earlier, the evaluation will favour the candidate with a normal application of r-deletion, an undesired result, as illustrated in the tableau below.

(254) Normal application of r-deletion — incorrect result

/ukor-RED/	PHONO- CONS	IO- FAITH	R=ROOT	MAX- BR
a. u.kor.ru.kor	*!			
b. ☞ *u.kor.ru.ko:			*	*
c. ☺ uko: ?u.ko:		*!	**	

The overapplication of r-deletion in (254c) spares a MAX-BR violation, but is nonetheless fatal, since it violates the dominant constraint IO-FAITH. This suggests that the overapplication of r-deletion in the base is not the outcome of MAX-BR.

The relevant constraint that springs to mind is ANCHOR (246), particularly ANCHOR-RIGHT<sup>12</sup> which demands that the right peripheral edge of the base correspond to the right peripheral edge of the reduplicant. Referring back to the possible candidates in tableau (254), candidates (254a) and (254c) are well-anchored, since the right peripheral elements of the reduplicant and the base are in correspondence. By contrast, candidate (254b) is miss-anchored because the right peripheral element of the reduplicant (i.e. [o]) does not correspond to the right element of the base (i.e. [r]).

<sup>12</sup> Another effect of ANCHOR-RIGHT is that it forces r-Deletion to underapply. A reduplicative pattern of underapplication will be pursued in the coming §5.4.3.

Another possible candidate which is also well-anchored but fails to emerge as the optimal output is \*[u.ko:.-u.ko:]. This form is ruled out because it disobeys the structural constraint ONSET. The leftmost member is allowed to be onsetless under the domination of ALIGN-LEFT, but not so the rightmost counterpart, which crucially needs an onset.


As shown in (242), in order to eschew the ONSET violation, a glottal stop is inserted between the two conjuncts. I argued in §5.4 that the epenthetic glottal stop must be assigned to the reduplicant, since otherwise the candidate in hand will also violate the undominated constraint ANCHOR-RIGHT, as well as IO-FAITH. The price of affiliating the glottal stop to the reduplicant is a minimal violation of DEP-BR, stated in (255).

(255) DEP-BR

Every segment of the reduplicant has a correspondent in the base.

DEP-BR must be ranked below R=ROOT and MAX-BR. In sum, the full hierarchy of constraints relevant to the overapplication of r-deletion from the reduplicant to the base is as follows: ANCHOR-RIGHT, PHONO-CONS >> IO-FAITH >> R=ROOT >> MAX-BR >> DEP-BR.

(256) Overapplication of r-deletion from the reduplicant to the base

/ukor-RED/	ANCHOR -RIGHT	PHONO- CONS	IO- FAITH	R= ROOT	MAX- BR	DEP- BR
a. u.kor.ru.kor		*!				
b. u.kor.ru.ko:	*!			*	*	
c.  u.ko:.?u.ko:			*	**		*

Note that ANCHOR-RIGHT, PHONO-CONS and IO-FAITH play crucial roles in evaluating the candidates in (256). The other three dominated constraints — R=ROOT, MAX-BR and DEP-BR — do not have any significant effect in the evaluation, and therefore they become irrelevant in the present case. The subranking ANCHOR-RIGHT, PHONO-CONS >> IO-FAITH established in (256) corresponds to the general ranking BR-IDENT, PHONO-CONS >> IO-FAITH, another general schema for deriving an overapplicative effect in reduplication (McCarthy & Prince 1995b).

Another case of overapplication from the reduplicant to the base involves Vowel Debuccalisation, driven by NO-LIGHT[a], which bars a low vowel [a] in a light syllable word finally (see §3.4). The optimal way of eschewing a violation of this PHONO-CONS is by debuccalisation, that delinks the [Place] node of a vowel. The price for feature delinking is a violation of IDENT-IO[Place] (74). The debuccalised vowel surfaces as a schwa in the output, as illustrated in the following examples.

(257)	Bare form	Affixed form	Reduplicated form
	[duwə] 'two'	[bəduwaʔan]	[duwə-duwə] [bəduwa-duwaʔan]
	[lamā] 'long (of time)'	[kəlamāʔān]	[lamā-lamā] [lamā-kəlamāʔān]
	[gilə] 'mad'	[kəgilaʔan]	[gilə-gilə] [kəgila-gilaʔan]



Observe that the final low vowel /a/ gets reduced to a schwa in the bare form, but not in the affixed form. This is phonologically expected, and NO-LIGHT[a] is irrelevant in the latter. Let us now turn to the reduplicated forms. As can be seen, the final vowel of the base is realised as either a schwa [ə] or a low vowel [a], depending on the final vowel of the reduplicant. Obviously, the alternation in the base is unrelated to PHON-CONS. Rather, the effect of IDENT-BR[F] regulates the identity between the correspondent segments in the base and the reduplicant in terms of feature specifications.

In the previous case of overapplication we have observed how the featural identity constraint IDENT-BR[Nasal] plays a crucial role in ensuring that Nasal Coalescence is applicable to both the base and the reduplicant. In the case under discussion, the relevant constraint at work is IDENT-BR[Place], as defined in (258).

(258) IDENT-BR[Place]

The correspondent segments in the base and the reduplicant must have identical values for the feature [Place].

Although IDENT-BR[Nasal] and IDENT-BR[Place] belong to the same constraint family, the two types of constraint are distinct, and therefore they are separately rankable in the hierarchy. As shown in (251), IDENT-BR[Nasal] is dominated by both IO-FAITH and PHONO-CONS. However, in this particular case it is crucial that IDENT-BR[Place] must outrank IO-FAITH, as the interaction in tableau (259) illustrates. Otherwise, the evaluation will yield an undesired result, as demonstrated in the next tableau, (260).

(259) Overapplication of Vowel Debuccalisation

/gila+RED/	IDENT-BR[Place]	PHONO-CONS	IO-FAITH
a. gila-gila		*!	
b. gila-gilə	*!		
c. ☞ gilə-gilə			*

The domination of IDENT-BR[Place] over IO-FAITH forces Vowel Debuccalisation in the base in the optimal candidate (259c). Candidate (259a) is the other good base-reduplicant match, but its phonology is fatally flawed. Candidate (259b) is phonologically well-behaved, except that the consequent lack of IDENT-BR[Place] ensures its elimination in the competition.

Similarly to the case of r-Deletion earlier, overapplication of Vowel Debuccalisation is governed by a general ranking schema BR-IDENT, PHONO-CONS >> IO-FAITH. The other type of general schema — PHONO-CONS >> IO-FAITH >> BR-IDENT — which is employed in the overapplication of Nasal Coalescence, is inapplicable in this particular case, because the ranking in hand yields an incorrect result as (260) shows.

(260) Normal application of Vowel Debuccalisation — incorrect result

/gila+RED/	PHONO-CONS	IO-FAITH	IDENT-BR[Place]
a. gila-gila	*!		
b. ☞ *gila-gilə			*
c. ☺ gilə-gilə		*!	*



### 5.4.1.3 Interactional overapplication: Vowel Nasalisation

Another type of overapplicational effect in reduplication is called interactional overapplication, where the base both triggers and copies the same phonological alternation. As McCarthy and Prince (1995b) point out, this kind of interaction between phonology and reduplication is only possible in a theory with parallel evaluation of fully-formed output structures.

A phonological process that involves interactional overapplication in Johore Malay is Vowel Nasalisation. Before we proceed, let's recall the general behaviour of this process in the phonology of the language. As we know from §4.7 above, vowels are nasalised in Johore Malay when they occur in a post-nasal environment, forced by a structural constraint  $*NV_{ORAL}$ , which states that in oral vowel cannot occur in post-nasal position. Nasality spreads from left to right, passing across the segments [j, w, h, ?], and across affix boundaries.

(261)	Root	Bare form	Reduplicated form	
	/uaŋi/	[waŋi]	[wãŋĩ-wãŋĩ]	'fragrant (intensified)'
	/hama/	[hamã]	[hãmã-hãmã]	'germ/germs'
	/hina/	[hinã]	[hĩnã-hĩnã]	'to look down upon'
	/uŋu/	[uŋũ]	[ũŋũ-ʔũŋũ]	'purple'
	/anai/	[anãj]	[ãnãj-ʔãnãj]	'termites'
	/inai/	[inãj]	[ĩnãj-ʔĩnãj]	'henna'

Observe that the vowel in the first syllable of the base is also nasalised in the reduplicated forms. This is irreconcilable with the context where nasalisation is derived in Malay phonology. In particular, the nasal segment /ŋ/ of the base /uaŋi/ spreads its nasality rightward to yield [waŋĩ]. As phonologically expected, nasality spreading then runs across the base-reduplicant juncture to the first syllable of the reduplicant, as in [waŋĩ-wãŋĩ]. However, the occurrence of nasality in the first syllable of the base [wãŋĩ-wãŋĩ], is outside the context of nasalisation.

The only possible source of nasality in the above-mentioned environment is the featural identity constraint IDENT-BR[Nasal] in (249), which requires that correspondent segments in the base and the reduplicant have identical values for the feature [nasal]. As can be seen in the above examples, the triggering condition of Vowel Nasalisation is found in the base. Therefore, IO-FAITH has to be violated in order to secure the satisfaction of PHONO-CONS (i.e.  $*NV_{ORAL}$ ). The lower ranked IDENT-BR[Nasal] then plays a decisive role in selecting the optimal form, which inevitably falls to an overapplicational candidate. This interaction gives the following partial constraint hierarchy: PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal].

Recall that this hierarchical ranking is exactly like the case of overapplication of Nasal Coalescence from the base to the reduplicant discussed in §5.4.1.1 above. The effect of PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal] in interactional overapplication is demonstrated in the tableau below.

#### (262) Interactional overapplication of Vowel Nasalisation

/uaŋi+RED/	PHONO-CONS	IO-FAITH	IDENT-BR[Nasal]
a. waŋĩ-waŋĩ	*!		
b. waŋĩ-wãŋĩ		*	**!
c. ʔ wãŋĩ-wãŋĩ		*	

Candidate (262a) is phonologically defective, as nasality has not spreaded across the following vowel segments [wa], giving a fatal violation of the higher-ranked PHONO-CONS. Forms (262b), the normal applicational candidate, and (262c), the overapplicational candidate, avoid this violation. They are tied on IO-FAITH violation. The decision then falls to IDENT-BR[NASAL], which selects the candidate with overapplication.

As was noted earlier, the effect of overapplication in reduplication can also be handled by a general ranking hierarchy BR-IDENT, PHONO-CONS >> IO-FAITH. Considering the case under discussion, the precise ranking is IDENT-BR[Nasal], PHONO-CONS >> IO-FAITH. This ranking is employed in McCarthy and Prince's (1995b) analysis in accounting for the reduplicative pattern described above.<sup>13</sup>

Considering exclusively the data given in (261), their analysis gives the right result, regardless of whether reduplication is pre-positive or post-positive, as the following tableaux illustrate.

(263) Overapplication of Vowel Nasalisation, assuming post-positive reduplication

/uaŋi+RED/	PHONO-CONS	IDENT-BR[Nasal]	IO-FAITH
a. <u>waŋi</u> - <u>waŋi</u>	*!		
b. <u>waŋi</u> - <u>ŵāŋi</u>		**!	*
c. <u>ŵāŋi</u> - <u>ŵāŋi</u>			*

(264) Overapplication of Vowel Nasalisation, assuming pre-positive reduplication

/RED+uaŋi/	PHONO-CONS	IDENT-BR[Nasal]	IO-FAITH
a. <u>waŋi</u> - <u>waŋi</u>	*!		
b. <u>waŋi</u> - <u>ŵāŋi</u>		**!	*
c. <u>ŵāŋi</u> - <u>ŵāŋi</u>			*

Candidates (263a, 264a) and (263c, 264c) have identical reduplicant + base pairs. The former is ruled out for phonological reasons, and therefore a dominant PHONO-CONS cannot be avoided. Candidates (263b, 264b) exemplify normal application, which can never be achieved when IDENT-BR[Nasal] is also dominant. Candidates (263c, 264c) emerge as the winner, where the base takes on the nasality of the reduplicant, despite the fact that the base itself is a main source of that nasality, and vice versa.

Given the facts of Johore Malay, the general ranking PHONO-CONS, BR-IDENT >> IO-FAITH adopted in McCarthy and Prince's (1995b) analysis is unsatisfactory for the simple reason that the ranking in hand cannot take into account the normal application of Vowel Nasalisation in forms such as [tahan-mānāhān] 'hit (reciprocity)' and [sajaŋ-māpājāŋ] 'love (reciprocity)'. These reduplicated forms are phonologically well-behaved.

By contrast, under the general ranking PHONO-CONS >> IO-FAITH >> BR-IDENT, the schema that is adopted in the present study, the phenomena of overapplication and normal application of Vowel Nasalisation can be accounted for satisfactorily. It is apparent that the

<sup>13</sup> In their analysis, McCarthy and Prince (1995b) employ a more specific version of the families of constraints PHONO-CONS and IO-FAITH, that is, \*N<sub>VORAL</sub>, \*V<sub>NASAL</sub> and IDENT-IO[Nasal]. These constraints are ranked as follows: IDENT-BR[Nasal], \*NV<sub>ORAL</sub> >> \*V<sub>NASAL</sub> >> IDENT-IO[Nasal].

present analysis is superior, as it can handle two different types of reduplicative patterns under a single constraint hierarchy. The reduplicative pattern of normal application will be pursued in length in §5.4.2.

#### 5.4.1.4 Previous account: a Global Theoretic approach

As mentioned earlier, the pioneer study of the interaction between phonology and reduplication in Johore Malay was Farid (1976)[1980], and the theoretical framework that underlies his analysis is Wilbur's (1973) Global Theory. The basic tenet of this theory is that phonology can detect the results of copying, through global rule interaction. Wilbur (1973a:72) states:

As I see it, the solution centers around the necessity for a rule to make use of the information that two segments ( $y_1$  and  $y_2$ ) are in a copy relationship to each other (one is the copy of the other) as a result of a morphological rule (Reduplication, Vowel Copy, etc.) ... The phonological rule must be allowed to "look back", presumably to the morphological component where the copying takes place and determine that two segments are in a copy-original relationship ... If the relationship of the original segment (in  $R_0$  [the base]) and its copy (in  $R_1$  [the reduplicant]) can be captured by the term "mate" and represented by a notation such as  $X$  and  $X'$ , then a global condition on a phonological rule which *overapplies* (regardless of whether it overapplies to  $R_0$  [the base] or  $R_1$  [the reduplicant]) can be written as:

$$X \text{ (and } X') \rightarrow Y \text{ if } AXB$$

When a rule *fails to apply*, it can be formulated:

$$X \text{ (and } X') \rightarrow Y \text{ if } X \text{ (and } X') / A \text{ } \underline{\hspace{1cm}} \text{ } B$$

Following the assumption of the standard theory (SPE), Global Theory approaches reduplication as a morphological rule whose application precedes that of the phonological rules. After reduplication has applied, the phonological rules which are assumed to be global scan both the input base and the output reduplicant to check for satisfaction of structural description. Rules can affect both conjuncts, though only one meets the requirement, or rules can demand that both forms meet the structural description. The rules in question are overapplication and underapplication, respectively. Both have identity-preserving effects. Rules can also apply normally, ignoring the identity-preserving relationship, and this is called normal application. The choice between over-, under-, or normal application is built into the statement of each rule, through the stipulation (or not) of the '(and X')' codicils (cf. McCarthy & Prince 1995b).

In short, in Global Theory the interaction between phonology and reduplication is controlled by a device called a global rule. The functional motivation for having a global rule is the tendency to maintain the identity of the original stem (the base) and its copy (the reduplicant). This tendency is referred to in Wilbur (1973a:58) as the Identity Constraint: There is a tendency to preserve the identity of  $R_n$  and  $R_r$  in reduplicated forms.

Farid (1980) argues that the global rule approach offers a more meaningful analysis of the phonologically aberrant behaviour of the root reduplication in Malay than the rule ordering approach or any other devices<sup>14</sup> proposed previously. Farid (1980:110) writes:

<sup>14</sup> Other logical possible devices that were proposed are (i) positing boundary markers, such as a special reduplication boundary or a word boundary between the two members of a reduplicated form, and (ii) positing an exception feature, so as to allow reduplicated forms to undergo a regular phonological rule, even though they do not satisfy the structural description of that rule. See Farid (1980:102–108) for details.

It appears that the proposed global rule analysis has the potential to handle, with greater insights and generality, all of the cases of apparent 'irregularity' of reduplicated forms in JM (Malay). Following Wilbur's analysis, Reduplication would be considered as a morphological rule whose application precedes that of the phonological rules ... After Reduplication has applied, the phonological rules would scan their immediate input strings; the rules would then 'look back' through the derivation to see if Reduplication has applied. Just in case it has applied, the rules would affect both the original and the copy, either applying or not applying to both, depending on whether the environment of these rules has been met or not by either member of the doubled forms. The global rule has been formulated by Wilbur (1973:117) as:  $X \text{ (and } X') \rightarrow Y \text{ if } AXB$ , which can be interpreted as:  $X$  and its mate  $X'$  (if there is one) become  $Y$  if  $X$  (but not necessarily  $X'$ ) is in the environment  $A\_B$ .

The global rule mentioned in the above summary solely refers to overapplication. Thus, phonological rules such as Nasal Coalescence, r-deletion, Vowel Nasalisation and Vowel Debuccalisation are specified as overapplying rules in the Malay grammar. To illustrate how a global rule works, consider the following examples, which involve the phonological rule of Vowel Debuccalisation that reduces the low final vowel /a/ into a schwa<sup>15</sup> in word final position.

(265)	/lama/	'long (of time)'	[lamã]
	/kə+lama+an/	'length of time'	[kəlamãʔã]
	/lama+lama/	'very long (of time)'	[lamã-lamã]
	/lama+kə+lama+an/	'as times go by'	[lamã-kəlamãʔã]

For the bare root /lama/, Vowel Debuccalisation would predictably apply, since its structural description is met, to derive the surface form [lamã]. When a suffix /-an/ is added to the root, this destroys the structural description of the rule, and expectedly Vowel Debuccalisation does not apply, giving the output form [kəlamãʔã].

In the case of reduplication the rule of Vowel Debuccalisation, assumed to be global, would scan the input representation /lama-lama/, to see whether its environment is satisfied by any member of the two conjuncts. Since the rightmost member satisfies the rule's environment, the rule then applies to both members, regardless of whether or not the other member meets the requirement. This derives the correct output [lamã-lamã].

On the other hand, in the reduplicative input /lama-kə-lama-an/, the environment is not met by either of the members, and therefore the rule will not apply, deriving the correct surface form [lama-kəlamãʔã].

Likewise, in the case of overapplication of Nasal Coalescence, the phonological rule would scan the reduplicative underlying form /məŋ-tari-tari/. Since the left conjunct meets the environment, the rule would expectedly apply to both members, to correctly derive [mənarɪ-nari]. The same derivation works for overapplication of r-deletion, as well as of Vowel Nasalisation.

Despite the fact that the Global Theoretic account manages to yield a correct result here, there is a major drawback of this approach: it only works for the overapplicational type of reduplicative phonology. For the cases of under- and normal application, which noticeably involve the same phonological rules, namely, r-Deletion, Nasal Coalescence and Vowel Nasalisation, this approach will just not work. Due to these facts, these two reduplicative patterns are disregarded in Farid's (1980) study. Therefore, his analysis on the phonology of Malay reduplication is inadequate observationally, descriptively and explanatorily.

<sup>15</sup> In the case under discussion, I focus merely on Vowel Debuccalisation, and the effect of Vowel Nasalisation will be ignored for simplicity.

As demonstrated above, the Global Theoretic approach seemingly works quite well in handling the three types of overapplications discussed thus far. There is another type of overapplication in the language which involves over-copying of a final-prefix C, and we shall explore this next. This reduplicative pattern poses a big problem for the global rule approach because no phonological rule operates here. What actually happens is that an extra segment is copied. The copied segment originates in a morpheme outside the usual domain of reduplication, the root.

#### 5.4.1.5 Over-copying of final-prefix C

Vowel initial roots exhibit another pattern of overapplication, as a consequence of the ONSET requirement. We have observed that Malay generally disfavors an onsetless syllable. A vowel can be onsetless in initial position under the domination of ALIGN-LEFT over ONSET.

Following the assumption that Johore Malay has suffixing reduplication (i.e. /Root+RED/), a base is permitted to be onsetless, but not a reduplicant. The onsetless reduplicant is resolved in two different ways, depending on whether the base is a bare root or an affixed root.

#### (266) V-initial root reduplication

Root	Bare root	Affixed root
/ada/ 'have'	[adə-ʔadə]	[mǝŋǝdǝ-ŋǝdǝ]
/alu/ 'welcome'	[alu-ʔalu]	[mǝŋǝlu-ŋǝlukan]
/api/ 'fire'	[api-ʔapi]	[bǝrapi-rapi] [mǝŋǝpi-ŋǝpikan] [api-mǝŋǝpi]
/ubah/ 'move'	[ubah-ʔubah]	[mǝŋǝubah-ŋǝubah] [bǝrubah-rubah] [ubah-mǝŋǝubah]
/ulaŋ/ 'repeat'	[ulaŋ-ʔulaŋ]	[mǝŋǝulaŋ-ŋǝulaŋ] [bǝrulaŋ-rulaŋ] [bǝrulaŋ-rulaŋŋǝn] [ulaŋ-mǝŋǝulaŋ]
/ikot/ 'follow'	[ikot-ʔikot]	[ikot-ʔikottan] [bǝrikot-rikot] [bǝrikot-rikottan]

Observe that in bare root reduplication, the ONSET requirement forces epenthesis of a glottal stop. R=ROOT bars this epenthetic segment from the reduplicant essentially because it is not part of the underlying root. In the case of affixed root reduplication, however, ONSET is satisfied by over-copying the prefix-final C, another instance of R=ROOT violation.

Before I offer an OT solution for the reduplicative patterns in (266), some important remarks with respect to the given data need to be clarified. Farid (1980:99) treats the process of overcopying of the final consonant of the prefix into the reduplicant as optional. He remarks in his footnote that his informant distinguishes the form which does not carry the optional nasal [ŋ] and [r], such as [mǝŋǝlu-alukan], [bǝrapi-api], etc., as being more formal. These are the forms written in literary Malay under the *Pedoman Umum Bahasa Malaysia* (the new spelling system of 1975).

This observation is opposed by Abdullah (1993), who holds that the form with overcopied consonant is the natural pronunciation of Malay. Interestingly, this is the form written under the old spelling system (i.e. *Ejaan Sekolah* (school spelling)), such as used in Za'ba (1953, 1954).

Another point of disagreement between the data given in (266) and Farid's (1980) is the occurrence of an epenthetic glottal at the base-reduplicant juncture. In Farid's (1980) transcription of bare root reduplication both the base and the reduplicant are onsetless, as in [a.lu.-a.lu], [a.pi.-a.pi], etc. Again, this transcription is adopted in the literary Malay.

Contrary to Farid (1980), I affirm that in the variety discussed here, the second conjunct of the reduplicated forms, that is, the reduplicant must begin with a glottal stop. By contrast, the first conjunct, that is, the base, has no epenthetic [ʔ], and therefore it remains onsetless in the surface, a clear violation of ONSET (cf. Teoh 1993:87; Abdullah 1993).

To proceed, let us first examine the bare root reduplication, with an epenthetic glottal stop. As we have understood the phonology of Malay, Glottal Epenthesis is an optimal means of resolving an onsetless syllable in the language, except for word initial and root internal positions. It is rejected in these positions to comply with the demands of the undominated constraints ALIGN-LEFT and ROOTCONTIG (see §2.4).

Glottal Epenthesis generally applies to break up an underlying hiatus, which is basically derived from concatenation of morphemes. Interestingly, in the case of reduplication, this rule constantly applies at the base-reduplicant juncture, even though there isn't any hiatus formed in that environment. This raises the question of why ambiskeletal parsing, a visibly active strategy to eschew the ONSET violation at the suffix boundary, is not applicable in the domain of suffixing reduplication. The answer to this question will be revealed as we proceed.

As demonstrated in (247), the epenthetic glottal must be affiliated to the reduplicant, since otherwise the candidate in hand incurs a fatal violation of ANCHOR-RIGHT (246). This constraint is undominated, and therefore it cannot be violated. The price paid for such an affiliation is a violation of R=ROOT.

Another argument supporting the claim that the epenthetic glottal is crucially part of the reduplicant comes from the interaction of the general ranking PHONO-CONS >> IO-FAITH >> BR-IDENT, which is used to derive an overapplicational effect.

If we assume that the epenthetic segment belongs in the base, IO-FAITH will be violated, specifically DEP-IO, which requires that every segment of the output have a correspondent in the input. On the other hand, if the segment is assigned to the reduplicant, BR-IDENT will be violated, in particular DEP-BR, which requires that every segment of the reduplicant have a correspondent in the base. The relevant PHONO-CONS constraint at work in the epenthesis process is ONSET.

In compliance with the general ranking above, the actual constraints are ranked as follows: ONSET >> DEP-IO >> DEP-BR. The effects of this ranking are shown in the following tableau.

(267) Glottal Epenthesis in the reduplicant

/ikot+RED/	ONSET	DEP-IO	DEP-BR
a. i.kot.-i.kot	**!		
b. i.kot.-ʔi.kot	*		*
c. i.kot.-i.kot	*	*!	



Note that the representations in (267b) and (267c) differ significantly, even though they are phonetically similar. In the latter, the epenthetic element is outside the reduplicant, and therefore it is not morphologically affiliated with RED. Therefore, it serves as the last segment of the base, which has no correspondent segment in the root, a fatal violation of DEP-IO. It also fails the undominated constraint ANCHOR-RIGHT (246), since the right peripheral segment [t] of the reduplicant does not correspond to the right peripheral segment [ʔ] of the base.

In the optimal candidate (267b), the glottal stop is affiliated to the morpheme RED. Since this segment has no correspondent in the base, a violation of DEP-BR is incurred. This violation, however, is irrelevant because DEP-BR is lower-ranked in the hierarchy.

Another possible candidate that should be considered is \*[i.ko.t-i.kot], in which the base-final consonant is resyllabified into the following syllable in the reduplicant. This candidate spares DEP-IO and DEP-BR, since there is no epenthesis involved, and violates ONSET only once. Thus, given the ranking in (267), it would be the most harmonic candidate. However, this is not the correct surface form, and therefore there must be a higher-ranked constraint that plays a crucial role in ruling it out.

The relevant constraint is ALIGN-RIGHT (125), which prohibits cross-junctural syllabification at the suffix boundary. ALIGN-RIGHT requires that the stem end exactly at a syllable edge. ALIGN-RIGHT and ONSET do not conflict, and so they don't have to be ranked with respect to each other.

(268) ALIGN-RIGHT, ONSET >> DEP-IO >> DEP-BR

/ikot+RED/	ALIGN- RIGHT	ONSET	DEP-IO	DEP-BR
a. i.kot .i.kot		**!		
b. i.ko.t i.kot	*!	*		
c. i.kot .ʔi.kot		*		*
d. i.kot .ʔi.kot		*	*!	

In (268), the right edge of the stem is indicated by '|', and the syllable boundaries are marked by a full stop '.'. In order for ALIGN-RIGHT to be fully satisfied, the right edge of the stem, that is, the stem-final segment, must coincide exactly with a syllable edge. Candidates (268a), (268c) and (268d) obey this requirement. By contrast, the potential candidate (268b) is mis-aligned, because the stem-final segment lies within a syllable.

Furthermore, there is a major flaw in (268b) with respect to identity of prosodic structure. Under the faithfulness and identity constraints discussed so far, we primarily focus on segments and features. It is argued in McCarthy and Prince (1995b) that constraints on correspondents also regulate the relation of such prosodic structure as mora, foot and syllable. Prosodic faithfulness or identity requires correspondent segments to have identical prosodic roles.

For the case under discussion, the relevant prosodic structure is the syllable, and this is controlled by a formal constraint MAX-BR<sub>SYLLABLE</sub>, which demands that correspondent segments in the base and the reduplicant must have identical syllabic roles. This reformulates the earlier syllable structure constraint called STROLE — A segment in R and its correspondent in B must have identical syllabic roles- introduced in McCarthy and Prince (1993a:Ch.7 and



1994). For consonants, the usual syllabic roles are onset and coda.<sup>16</sup> Candidate (268b) disobeys this requirement since the segment /t/ plays two different roles in the representation, as an onset in the base, but as a coda in the reduplicant.

Note that a form such as \*[i.kot.-kot] is also possible, where a violation of ONSET is spared by duplicating only the second syllable. This candidate and the optimal one [i.kot.-?i.kot] in (268c) both violate R=ROOT equally. They are then distinguished by the identity constraints MAX-BR (240), which is compelled by the failed candidate \*[i.kot.-kot], and DEP-BR (255), which is violated by the optimal candidate [i.kot.-?i.kot]. In order for the latter to emerge as the winner, obviously DEP-BR must be ranked lower than MAX-BR in the hierarchy.

(269) ALIGN-RIGHT, ONSET >> DEP-IO >> R=ROOT >> MAX-BR >> DEP-BR

/ikot+RED/	ALIGN- RIGHT	ONSET	DEP-IO	R= ROOT	MAX-BR	DEP-BR
a. i.kot.- <u>i.kot</u>		**!				
b. i.ko.t- <u>i.kot</u>	*!	*				
c. <sup>☞</sup> i.kot.- <u>?i.kot</u>		*		*		*
d. i.kot.- <u>kot</u>		*		*	*!	
e. i.kot.- <u>?i.kot</u>		*	*!			

Thus far we haven't considered a candidate that has a geminate, such as \*[i.kot.t-i.kot]. In the ordinary suffixation, the occurrence of geminate consonants at the suffix boundary is triggered by the conspiracy to satisfy ALIGN-RIGHT and ONSET (see §3.2). Recall that the price for gemination is a violation of INTEGRITY-X (30), which militates against structure with multiple association.

Interestingly, in suffixational reduplication gemination is permitted in the reduplicant but not in the base. Thus, from the underlying form /ikot+RED+an/, the correct surface output will be [i.kot.-?i.kot.tan], and not \*[i.kot.t-i.kot.tan]. Observe that the failed candidate \*[i.kot.t-i.kot.tan] satisfies MAX-BR and DEP-BR, respectively, and yet it is not optimal. To account for this, we need to have two distinct and separately rankable INTEGRITY-X constraints as in (270).

(270) a. INTEGRITY-IO<sub>x</sub>

No element of the input has multiple X correspondents in the output

b. INTEGRITY-BR<sub>x</sub>

No element of the base has multiple X correspondents in the reduplicant

Under the general ranking PHONO-CONS >> IO-FAITH >> BR-IDENT adopted thus far, the faithfulness constraint (270a) has to dominate the identity constraint (270b). The tableau in (271) illustrates this effect.

<sup>16</sup> Seeing onset and coda as syllabic roles does not presume the existence of Onset and Coda constituents. The onset and coda roles can be read off syllabic structure without recognising labeled Onset and Coda constituents (McCarthy & Prince 1994:34)

(271) ONSET >> INTEGRITY-IO<sub>x</sub> >> INTEGRITY-BR<sub>x</sub>

/ikot+RED+an/	ONSET	INTEGRITY-IO <sub>x</sub>	INTEGRITY-BR <sub>x</sub>
a. i.kot.i.ko.tan	**!		
b. i.kot.ti.kot.tan	*	*!	
c. i.kot.ʔi.kot.tan	*		*

Note that the optimal candidate (271c) is well-anchored, since the right peripheral segment of the base corresponds to the right peripheral segment of the reduplicant. It is crucially assumed that ANCHOR-RIGHT is fully satisfied, as long as the two segments are in correspondence, and it does not matter whether the correspondence relation between base and reduplicant is represented by a single [t] or by a geminate [tt]. The relevant constraint that is violated here is INTEGRITY-BR<sub>x</sub>.

In sum, in the bare V-initial root reduplication, the requirement for ONSET in the reduplicant is achieved by Glottal Epenthesis, at the expense of violating R=ROOT and two other formal constraints that belong to the BR-IDENT constraint family, namely DEP-BR and INTEGRITY-BR<sub>x</sub>. All other possible candidates are ruled out, as they compel violations of the higher-ranked constraints, such as ALIGN-RIGHT, ONSET, and the formal constraints of the IO-FAITH family, such as IDENT-IO and INTEGRITY-IO<sub>x</sub>.

We now move to the prefixed V-initial root reduplication, where the candidate with the epenthetic glottal stop does not emerge as the optimal output. As shown in the examples given in (266), there is another means of resolving the ONSET requirement in the reduplicant, that is, by over-copying the final consonant of the prefix. Since this segment is not part of the underlying root, R=ROOT is surely violated. If that is the case, what makes the candidate with prefix-final C over-copying (e.g. [məŋikot-ŋikot]) more harmonic than the one with the epenthetic glottal stop (e.g. \*[məŋikot-ʔikot])?

Considering the constraints discussed thus far, neither candidate will be more harmonic than the other. Both violate and satisfy the available constraints equally, i.e. are completely in a tie position, assuming that [ʔ] or [ŋ] in the reduplicant corresponds to [ŋ] in the base.

(272) Underlying form /məŋ+ikot+RED/ 'follow (intensity, repetition)'

Constraint evaluation	*[məŋikot-ʔikot]	[məŋikot-ŋikot]
ONSET	no violation	no violation
ALIGN-RIGHT	no violation	no violation
ANCHOR-RIGHT	no violation	no violation
IO-FAITH	no violation	no violation
R=ROOT	violation	violation
MAX-BR	violation	violation
DEP-BR	no violation	no violation

In the overapplication case involving Nasal Coalescence (§5.4.1.1) and Vowel Nasalisation (§5.4.1.3), we have observed that IDENT-BR[Nasal] plays a crucial role in determining the optimal candidate. This constraint demands that the correspondent segments in the base and the reduplicant be identical in the value of the feature [nasal], and is ranked above R=ROOT. It seems that IDENT-BR[Nasal] is relevant here, in eliminating the sub-optimal candidate \*[mə.ŋi.kot.-ʔi.kot], since the correspondent segments [ŋ] and [ʔ] are featurally dissimilar.

Note that the form [bə.ri.kot.-ri.kot] is also the outcome of prefix-final C overcopying triggered by ONSET. Obviously, the choice between the optimal form [bə.ri.kot.-ri.kot] and the suboptimal form \*[bə.ri.kot.-ʔi.kot] cannot be distinguished by IDENT-BR[Nasal], since there is no nasal segment involved here. A more general constraint that can capture the overcopying of prefix-final C is simply IDENT-BR[F], which requires that reduplicant correspondents of a base [ɣF] segments are also [ɣF]. This constraint guarantees a perfect copy of the C-segment.

Another possible candidate \*[məŋikot.-kot] (or \*[bərikot.-kot]) avoids a violation of IDENT-BR[F], but is less harmonic, as it contains more violations of MAX-BR. The complete ranking of constraints is as follows: ANCHOR-RIGHT, ONSET, ALIGN-RIGHT >> IO-FAITH >> IDENT-BR[F] >> R=ROOT >> MAX-BR. The effects of this ranking are demonstrated in tableau (273) below.

(273) Overcopying of prefix-final C

/məŋ+ikot+RED/	ONSET, ANCHOR-RIGHT, ALIGN-RIGHT	IO- FAITH	IDENT- BR[F]	R= ROOT	MAX- BR
a. mə.ŋi.kot.-i.kot	ONSET *!				***
b. mə.ŋi.ko.t-i.kot	ALIGN-RIGHT *!				***
c. mə.ŋi.kot.-ʔ-i.kot	ANCHOR-RIGHT *!	*			****
d. mə.ŋi.kot.-ʔi.kot			*!	*	**
e. mə.ŋi.kot.-kot				*	***!*
f. mə.ŋi.kot.-ŋi.kot				*	**

In sum, overcopying of prefix-final C is triggered by the syllable structure constraint ONSET, which requires that every syllable must have an onset. At the same time, the reduplicative identity constraints, such as IDENT-BR[F] and MAX-BR, which demand the reduplicant to be as closed as possible to the base, are also at play. To conform with these demands, the choice inevitably falls to the candidate that undergoes overcopying.

Overcopying of prefix-final C in V-initial root reduplication is common cross-linguistically. For example, in Tagalog (Carrier-Duncan 1984; Marantz 1982, 1987), when the reduplicative morpheme RED is preceded by a C-final Prefix, as in /naŋ+RED+isda/, the preceding /ŋ/ surfaces in both conjuncts as [naŋi-ŋisda], and not as \*[naŋ-i-isda]. A similar state of affairs occurs in Chumash (Applegate (1976), quoted from McCarthy and Prince 1995b), where an underlying form /s+RED+ikuk/ surfaces in the reduplicated form as [sik-sikuk], and not as the expected \*[sik-ikuk].

Let us now see how this generalisation is captured in the rule-based approach of Global Theory. As we have seen earlier, overapplication is controlled by a device called a global rule, which is motivated by the Identity Constraint. The phonological rule that has been specified as a global rule has the power 'to look back' through the derivation, after reduplication has applied, searching for the structural description. The rule would affect both the base and the reduplicant, even though the environment of this rule is met by only one of the members.

Considering the case under discussion, this approach will not work, for one simple reason. The occurrence of prefix-final C in the reduplicant is not the effect of any phonological rule, and therefore the notion of global rule is irrelevant in this context. Although the process of building syllable structure, e.g. the onset, does involve a phonological operation, this is not explicitly formalised as a phonological rule in the Global Theory approach.

Since there is no phonological rule that can be considered a global rule, Farid (1980:111) suggests that the global condition is manipulated by the morphological rule of reduplication. In his footnote 21, he states that:

It appears that there is also a necessity to make reduplication global in order to handle vowel-initial stems ... as opposed to voiceless consonant-initial stems. With reduplication being global, it would then have the power to copy the stem with or without the final nasal of the prefix. In order to determine whether copying of the final nasal of the prefix is obligatory or optional, reduplication has to look back in the derivation to see if the input string has undergone VO-Deletion [Nasal Coalescence]. Just in case it has, reduplication would then obligatorily copy the final nasal of the prefix before the rightmost member of the doubled stems, and Nasal Assimilation and VO-Deletion would apply regularly to both members [i.e. [məmukol-mukol]]. On the other hand, if the input string contains a stem which does not undergo VO-Deletion [in this case, vowel-initial stems] Reduplication may only optionally copy the final nasal of the prefix before the rightmost member. Incidentally, by allowing a morphological rule like Reduplication to be global, the operation of global conditions would become more general in that they could be used to govern not only the operation of phonological processes, but also morphological processes. (The bracket is mine)

However the operation of global rules in reduplication seems to be too powerful because the derivation would then generate an ungrammatical surface form, as we will see shortly.

As suggested in Farid (1980), following Wilbur (1973), the functional motivation of having a global rule is the tendency to maintain the identity of the original stem and its copy — which Wilbur terms the Identity Constraint. The global operation of Nasal Coalescence does seem to be functionally motivated in this respect. This rule causes a significant change in the stem, as in /məŋ+tari/ becoming [məŋari], and this modification would then have to be carried over to the other member [məŋari-nari], in order to preserve identity between the two forms. In other words, the overapplication of Nasal Coalescence is triggered by the Identity Constraint.

The question is, does the operation of the global rule in reduplication have a similar functional motivation? Unfortunately, the answer is no. For instance, in the reduplicative input /məŋ+alu+alu/ 'to welcome with intensity', it is argued that, by being global, the process of reduplication has the power to look back and copy the final nasal of the prefix, to derive the optional surface form [məŋalu-ŋalu].

Farid (1980:111) noted that whether the surface output is [məŋalu-alu] or [məŋalu-ŋalu], in either form, the identity of both members would be maintained, or partially maintained. This observation is oversimplified, because with such a power the reduplication process could also copy the whole prefix, to derive the surface form \*[məŋalu-məŋalu]. As far as the Identity Constraint is concerned, this form is far better, because the identity of both members is fully maintained, whereas in [məŋalu-ŋalu] it is partially maintained. Unfortunately, \*[məŋalu-məŋalu] is not the correct surface form.

To sum up, the extension of global rules to the morphological process of reduplication does not prove to be functionally motivated, especially with respect to the Identity Constraint, the tendency to maintain the identity of the original stem and its copy. If this constraint is satisfied, the derivation will end in an ungrammatical output.

### 5.4.2 Normal application: Nasal Harmony

As was commented in Chapter 1, the reduplicative pattern of normal application was not explored in Farid's work (1980), despite the fact that it is widely used in the morphology of the language (cf. Asmah 1975; Abdullah 1974). Normal application contradicts the assumption of identity preservation, as both the base and the reduplicant go separate ways phonologically, without regard for the identity linkage between them.<sup>17</sup>

The phenomenon of normal application becomes more problematic when it involves a phonological process that also occurs in the reduplicative pattern of overapplication. This is exactly the situation in Malay where phonological processes like Nasal Coalescence and Vowel Nasalisation are visibly active in both over- and normal application.

In (274) I display some relevant examples, with the root in the first column, overapplication in the second column and normal application in the third column. Semantically, normal application denotes the meaning of reciprocity, whereas overapplication connotes the meaning of intensity or repetition.

(274)	Root	Overapplication	Normal application
	[tahan] 'stop'	[mənāhān-nāhān]	[tahan-mənāhān]
	[kajoh] 'paddle'	[mənājōh-ŋājōh]	[kajoh-mənājōh]
	[suwap] 'feed'	[mənūwāp-nūwāp]	[suwap-mənūwāp]
	[pahat] 'chisel'	[mēmāhāt-māhāt]	[pahat-mēmāhāt]

Note that in the forms in the third column the processes of Nasal Coalescence and Vowel Nasalisation only apply to the rightmost members, as their structural descriptions are only met there. Unlike the forms in the second column, these phonological modifications are not transmitted to the other members, a clear case of disobedience of BR-IDENT.

As in the Johore Malay case, Nasal Coalescence (i.e. Nasal Substitution) in Indonesian Malay (Cohn & McCarthy 1994; McCarthy & Prince 1995b) can be over- and normally applied in the morphological domain of reduplication. McCarthy and Prince (1995b) point out that the nasal-coalescence-triggering prefix /məN-/ can either precede the reduplicative conjunct, as in (275a), or fall between the two conjuncts, as in (275b), denoting a difference in meaning. Overapplication prevails when /məN-/ is preposed, and normal application when /məŋ-/ is interposed, as the following examples show.

- (275) Overapplication and normal application in Indonesian (McCarthy & Prince 1995)
- a. Preposed Prefix. /məN-B-R/ — overapplication
 


potonj	məmotonj-motonj	'cut (intens., repet.)'
tulis	mənulis-nulis	'write (intens., repet.)'
  - b. Interposed Prefix. /B-məN-R/ — normal application
 

pukul	pukul-məmukul	'hit (recip.)'
tari	tari-mənari	'dance (recip.)'


<sup>17</sup> It must be noted that the term 'normal application' employed here does not imply that this pattern is prevalent in languages. Rather, it suggests that this form is well-behaved phonologically, as if the base and the reduplicant were two completely independent entities.

McCarthy and Prince (1995b) account for overapplication and normal application of Nasal Coalescence in Indonesian by proposing a schematic ranking PHONO-CONS >> IO-FAITH >> BR-IDENT. Overapplication is illustrated in tableau (276), while normal application is shown in tableau (277).

(276) Overapplication in Indonesian Nasal Coalescence (preposed prefix)

/məŋ+tulis+RED/	PHONO-CONS	IO-FAITH	BR-IDENT
a. məntulis-tulis	*!		
b.  mənulis-nulis		*	
c. mənulis-tulis		*	*

(277) Normal application in Indonesian Nasal Coalescence (interposed prefix)

/tari+məŋ+RED/	PHONO-CONS	IO-FAITH	BR-IDENT
a. tari-məntari	*!		
b. nari-mənari		*!	
c.  tari-mənari			*

Note that this ranking is precisely the system that has been employed to account for all the three types of overapplications discussed earlier. Recall that the overapplicational effects of Nasal Coalescence (§5.4.1.1) and Vowel Nasalisation (§5.4.1.3) are controlled by the same sub-hierarchical ranking, that is, PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal]. This is not surprising because the two processes are closely related to each other.

As shown in §4.7, Nasal Coalescence and Vowel Nasalisation demonstrate a feeding order relationship in the terminology of the rule-based approach. The application of Nasal Coalescence triggers the spreading of nasality progressively to the following vowels, penetrating the laryngeal consonants [h, ʔ], until it is blocked by an oral consonant.<sup>18</sup> For convenience, in this section I use the general term Nasal Harmony to refer to these two processes.

Following McCarthy and Prince's (1995b) analysis of Indonesian, I crucially assume that the nasal-coalescence-triggering prefix /məŋ-/ in Malay can be either a preposed prefix or an interposed prefix, denoting a difference in meaning. In the former the prefix /məŋ-/ precedes the root and the reduplicative morpheme RED (i.e. /məŋ+ tahan+RED/ 'to stop repeatedly or intensively'), and this gives rise to a reduplicative pattern of overapplication. In the latter, the prefix falls between the Root and the morpheme RED (i.e. /tahan+məŋ+RED/ 'to stop reciprocally') to yield a normal applicational effect.

In the case of overapplication, as demonstrated in §5.4.1.1 and §5.4.1.3, the primary target of PHONO-CONS is the base. Thus, IO-FAITH has to be violated while PHONO-CONS is satisfied. The phonological effect in the base is then transmitted to the reduplicant due to the demand of the base-reduplicant identity constraint IDENT-BR[Nasal].

<sup>18</sup> In McCarthy and Prince's (1995b) analysis of Indonesian they only focus on the overapplication and normal application of Nasal Coalescence. The effect of Vowel Nasalisation on these two reduplicative patterns has not been previously explored.

## (278) Overapplication in Malay Nasal Harmony

/məŋ+tahan+RED/	PHONO- CONS	IO- FAITH	IDENT- BR[Nasal]
a. məntahan- <u>tahan</u>	*!		
b. ☞ mǝnāhān- <u>nāhān</u>		*	
c. mǝnāhān- <u>tahan</u>		*	***!

As I have pointed out in the earlier discussion, there is a significant distinction between the evaluation of the faithfulness constraint IO-FAITH and the evaluation of the reduplicative constraint BR-IDENT. The former is evaluated categorically, while the latter is evaluated gradiently.

However, in the case of normal application, it is the reduplicant that constitutes the focus of the operation. Any phonological modification of the reduplicant is not counted as an IO-FAITH violation, which is therefore vacuously satisfied. However, obedience to IDENT-BR[Nasal] by the base compels an IO-FAITH violation. This is fatal, because IO-FAITH dominates IDENT-BR[Nasal] (see 262). The following tableau demonstrates this fact:

## (279) Normal application in Malay Nasal Harmony

/tahan+məŋ+RED/	PHONO- CONS	IO- FAITH	IDENT- BR[Nasal]
a. tahan-məntahan	*!		
b. ☞ tahan-mǝnāhān			*
c. nāhān-mǝnāhān		*!	

In sum, the interaction of the phonological process of Nasal Harmony and reduplication demonstrates two different patterns of reduplicative phonology, namely over- and normal application. Both are jointly controlled by the general ranking PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal].

It must be noted that, under this constraint hierarchy, a normal applicational effect can only be captured if the reduplicative morpheme RED is analysed as a suffix. Otherwise, the evaluation procedure will select an overapplied candidate as optimal, an undesired result, as tableau (280) shows.

## (280) Pre-positive Reduplication — incorrect result

/RED+məŋ+tahan/	PHONO- CONS	IO- FAITH	IDENT- BR[Nasal]
a. <u>tahan</u> -məntahan	*!		
b. ☺ <u>tahan</u> -mǝnāhān		*	*!
c. ☞ * <u>nāhān</u> -mǝnāhān		*	

The candidate with normal application (280b) cannot emerge as the optimal output when the target of PHONO-CONS is the base, because IO-FAITH has to be violated anyway. Reduplication is then called on to copy it, even with the low-ranking IDENT-BR[Nasal]. Thus, the overapplicational candidate (280c) will always be favoured.



As was mentioned in §5.4.1.3, McCarthy and Prince (1995b) employ a general ranking PHONO-CONS, BR-IDENT >> IO-FAITH to account for overapplication of Vowel Nasalisation in Malay. This ranking has to be discarded because, while it works for overapplication, it totally fails for normal application, as we shall see shortly.

Let us first observe how the ranking PHONO-CONS, BR-IDENT >> IO-FAITH drives overapplication. Since IO-FAITH is in the lowest position under this hierarchical ranking, its effect is not so significant. Whether it is satisfied or not, the decision is always resolved by the high-ranked IDENT-BR[Nasal]. In this case, which form constitutes the target of PHONO-CONS is irrelevant. Therefore, whether the reduplicative morpheme RED is pre-positive or post-positive, the evaluation will always yield the correct result, as shown in (281) and (282) below.

(281) Overapplication of Nasal Harmony, assuming post-positive Reduplication

/məŋ+tahan+RED/	PHONO-CONS	IDENT-BR[Nasal]	IO-FAITH
a. məntahan-tahan	*!		
b. mənāhān-tahan		*!	*
c. ☞ mənāhān-nāhān			*

(282) Overapplication of Nasal Harmony, assuming pre-positive Reduplication

/məŋ+RED+tahan/	PHONO-CONS	IDENT-BR[Nasal]	IO-FAITH
a. məntahan-tahan	*!		
b. mənāhān-tahan		*!	
c. ☞ mənāhān-nāhān			*

This ranking, however, is unsuccessful in accounting for the effect of normal application. Whether the RED morpheme is pre-positive or post-positive, the in fact sub-optimal overapplicational candidate \*[nāhān-mənāhān] inevitably emerges as the winner, as illustrated in tableaux (283) and (284).

(283) Pre-positive Reduplication — incorrect result

/RED+məŋ+tahan/	PHONO-CONS	IDENT-BR[Nasal]	IO-FAITH
a. tahan-məntahan	*!		
b. ☺ tahan-mənāhān		*!	*
c. ☞ *nāhān-mənāhān			*

## (284) Post-positive Reduplication — incorrect result

/tahan+məŋ+RED/	PHONO- CONS	IDENT- BR[Nasal]	IO- FAITH
a. <u>tahan-məntahan</u>	*!		
b. ☺ <u>tahan-mənāhān</u>		*!	
c. ☞ * <u>nāhān-mənāhān</u>			*

It must be mentioned that the analysis proposed in the tableaux above is set within the Basic Model. In the following, I attempt to employ the Full Model system, so that the general ranking PHONO-CONS, IDENT-BR[Nasal] >> IO-FAITH can be maintained. In the Full Model approach there is a subsidiary constraint called IR-FAITH (IR-Faithfulness), which demands that the output reduplicant must be faithful to the input stem. This constraint must outrank IO-FAITH in order to be visibly active.

The schematic ranking of the relevant constraints is now as follows: PHONO-CONS >> IR-FAITH >> IDENT-BR[Nasal] >> IO-FAITH. Under this ranking hierarchy, the reduplicative morpheme RED must be analysed as a prefix.

## (285) Normal application in Full Model

/RED+məŋ+tahan/	PHONO- CONS	IR- FAITH	IDENT- BR[Nasal]	IO- FAITH
a. <u>tahan</u> -məntahan	*!			
b. ☞ <u>tahan</u> -mənāhān			*	*
c. <u>nāhān</u> -mənāhān		*!		*

## (286) Overapplication in Full Model

/məŋ+RED+tahan/	PHONO- CONS	IR- FAITH	IDENT- BR[Nasal]	IO- FAITH
a. <u>məntahan</u> -tahan	*!			
b. <u>mənāhān</u> -tahan		*	*!	*
c. ☞ <u>mənāhān</u> -nāhān		*		*


As noted, although the Full Model analysis is logically possible, it is argued that the relation between the reduplicant and the input, via IR-Faithfulness, is impossible for principled reasons (McCarthy & Prince 1995b). First, the output reduplicant has no access to the input stem except through the output base, and therefore it can never be more faithful to the input than the base. Second, the Root-Affix Faithfulness Metaconstraint (230), imposes that Root-Faithfulness must always dominate Affix-Faithfulness, and this ranking is universally fixed. Because of this metaconstraint, no IR-FAITH constraint can ever dominate an IO-FAITH constraint.

In addition to the above arguments, the Full Model cannot be employed in Malay because it fails to work for the case of over- and normal application that involves V-initial roots. Table (287) displays some examples of overapplication, in particular the over-copying of prefix-final C in the second column, and normal application in the third column.


(287)	Root	Overapplication	Normal application
	[useʔ] 'touch'	[mǝŋūseʔ-ŋuseʔ]	[useʔ-mǝŋūseʔ]
	[ulaŋ] 'repeat'	[mǝŋūlaŋ-ŋūlaŋ]	[ulaŋ-mǝŋūlaŋ]
	[edʒeʔ] 'tease'	[mǝŋēdʒeʔ-ŋēdʒeʔ]	[edʒeʔ-mǝŋēdʒeʔ]

As discussed in §5.4.1.5, the process of overcopying the prefix-final C is triggered by the syllable structure constraint ONSET. Onsetless syllables are generally dispreferred in this language, except in word-initial position, due to the higher-ranked ALIGN-LEFT. An epenthetic glottal cannot occur in prefixed reduplication, as it compels an IDENT-BR[Nasal] violation. The hierarchical ranking of the relevant constraints here is ALIGN-LEFT >> ONSET >> IR-FAITHFULNESS >> IDENT-BR[Nasal] >> IO-FAITH.

(288) Overcopying of prefix-final C — correct result

/mǝŋ+RED+ikot/	ALIGN-LEFT	ONSET	IR-FAITH	IDENT-BR[Nasal]	IO-FAITH
a. mǝŋikot-ikot		*!			
b. mǝŋikot-ʔikot			*	*!	*
c.  mǝŋikot-ŋikot			*		*


(289) Overcopying of prefix-final C — incorrect result

/RED+mǝŋ+ikot/	ALIGN-LEFT	ONSET	IR-FAITH	IDENT-BR[Nasal]	IO-FAITH
a. ☹ ikot-mǝŋikot		*!			
b. ʔikot-mǝŋikot			*!	*	
c.  *ŋikot-mǝŋikot					

As shown in (289), all the possible candidates satisfy ALIGN-LEFT. Since the underlying form of the reduplicative morpheme RED is phonologically unspecified, all the reduplicants are equally well aligned, and thus ALIGN-LEFT is irrelevant here (McCarthy & Prince 1993:67, 1994:27). The next constraint, ONSET, incorrectly eliminates the desired candidate (289a).

On the other hand, under the Basic Model approach, both cases of normal and overcopying of prefix-final C can be resolved under the same hierarchical ranking, ALIGN-LEFT >> ONSET >> IO-FAITH >> IDENT-BR[Nasal].

(290) Over-copying in the Basic Model

/mǝŋ+ikot+RED/	ALIGN-LEFT	ONSET	IO-FAITH	IDENT-BR[Nasal]
a. mǝŋikot-ikot		*!		
b. mǝŋikot-ʔikot				*!
c.  mǝŋikot-ŋikot				

## (291) Normal application in the Basic Model

/ikot+məŋ+RED/	ALIGN-LEFT	ONSET	IO-FAITH	IDENT-BR[Nasal]
a.  i.kot - mə.ŋi.kot		*		
b. ?i.kot - mə.ŋi.kot	*!		*	*
c. ŋi.kot - mə.ŋi.kot	*!		*	

The word-initial glottal stop [ʔ] and velar nasal [ŋ] in candidates (291b) and (291c) are not part of the underlying morphological word /ikot/. So, they are epenthetic segments which force a mis-alignment between the edge of the morphological word and the edge of a syllable, a fatal violation of ALIGN-LEFT. They also violate IO-FAITH, specifically DEP-IO. Although the optimal candidate (291a) disobeys the high-ranked ONSET, it is the most harmonic among the available candidates.

In sum, considering the case of over- and normal application discussed thus far, the Basic Model evidently offers a better analysis of the regularities of those forms than the Full Model. I have shown that the alternation triggered by PHONO-CONS is located in the reduplicant, and therefore any phonological modification that has taken place is not reckoned as an IO-FAITH violation. This phonological effect cannot be carried over to the base, because obedience to IDENT-BR[Nasal] compels an IO-FAITH violation. Consequently, the base always preserves its input form in the surface representation.

Under the global rule approach, the interaction between the phonological rule of Nasal Harmony and reduplication is very difficult, if not impossible, to account for. Since this rule has already been specified as an overapplying rule, as predicted by the Global Theory, it will apply to both conjuncts, even though the structural description is met by only one of the members.

For the case under discussion, the rule of Nasal Harmony will scan the input representation /tahan+məŋ+tahan/, to search whether or not its environment is satisfactorily met by any of the two members. Since the rightmost member meets the condition, the rule then expectedly applies to both members to derive an incorrect surface form \*[nāhān-mānāhān]. In short, the Global Theoretic account of the phonology of Nasal Harmony in Malay reduplication is descriptively and explanatorily inadequate.

### 5.4.3 Underapplication: r-Deletion

Another shortcoming of the Global Theoretic approach in accounting for the phonology of Malay reduplication can be witnessed in the reduplicative pattern of underapplication involving the process of r-Deletion. As mentioned, r-Deletion is very regular in the language, driven by the CODA COND constraint ALIGN-RHOTIC, which bans the /r/ from occupying the syllable coda position. One way of eschewing the ALIGN-RHOTIC violation is by omitting the /r/.

However, in the morphological domain of reduplication, as demonstrated in §5.4.1.2, this process exhibits irregular phonological behaviour, that is, r-Deletion is not triggered by the phonological constraint ALIGN-RHOTIC. The deletion of /r/ in the reduplicative environment is a consequence of the base-reduplicant identity constraint ANCHOR-RIGHT, which demands that the right peripheral edge of the base must correspond to the right peripheral edge of the reduplicant. The interaction between r-Deletion and reduplication is here referred to as overapplication.

The converse process of overapplication is called underapplication. Both over- and underapplication essentially involve the requirement that the identity between the base and the reduplicant be maintained. Underapplication generally refers to the case where some phonological rules fail to operate to either the base or the copy, even though the relevant structural description is met in one of them.

This is another case of irregular behaviour of r-Deletion, not totally expected on purely phonological grounds. In (292) I list some relevant examples showing the underapplication of Malay r-Deletion. Bare root reduplication in the second column exhibits the regular pattern of r-Deletion, whereas affixed root reduplication in the third column displays an irregular one.

(292)	Root	Bare root	Affixed root
	/bəsar/ 'big'	[bəsa:-bəsa:]	[bəsar-bəsarran]
	/saioɾ/ 'vegetable'	[sajo:-sajo:]	[sajoɾ-sajorran]
	/kədʒar/ 'chase'	[kədʒa:-kədʒa:]	[bəkədʒar-kədʒarran]
	/taboɾ/ 'spread'	[tabo:-tabo:]	[bətaboɾ-taborran]
	/samar/ 'blur'	[sama:-sama:]	[kəsamar-samarran]

The reduplicated forms in the second column are phonologically well-behaved, as both members delete the coda-r in agreement with the PHONO-CONS (i.e. ALIGN-RHOTIC) requirement. By contrast, the forms in the third column, particularly the leftmost member of the reduplicated forms, do not undergo r-Deletion, even though its triggering condition is fully satisfied. This is a typical instance of underapplication.

As noted, underapplication is interactionally similar to overapplication, in the sense that both are forced to maintain the identity of the base and the reduplicant as closely as possible, driven by BR-IDENT. McCarthy and Prince (1995b) note that in every underapplicational situation, there must be a blocking constraint C' that is being satisfied along with BR-IDENT, blocking the effects of the PHONO-CONS >> IO-FAITH subhierarchy. They argue that all proposed cases of underapplication come under the general ranking in (293).

(293) General ranking for underapplication (McCarthy & Prince 1995b:254)

BR-IDENT, C' >> PHONO-CONS >> IO-FAITH

This ranking results in underapplication simply because the regular phonological alternation which is due to the sub-hierarchy PHONO-CONS >> IO-FAITH is blocked by C' in certain environments, and in this particular case the reduplication happens to be one of such environments. When the higher ranked BR-IDENT has to be obeyed, together with a blocking constraint C', the only means to preserve the identity between the base and the reduplicant is to avoid the regular alternation.

It is claimed that in many cases of underapplication the blocking constraint C' is straightforwardly phonological. For instance, in the case of underapplication in Akan Palatalisation (McCarthy & Prince 1995b) the blocking constraint at play is the OCP. This phonological constraint prevents the regular process of Palatalisation from applying in the morphological domain of reduplication if its application would result in a coronal-coronal sequence.

Now let us turn to the case of the underapplication of r-Deletion in Malay. In order to account for this reduplicative pattern our main task is to identify the blocking constraint C', which plays a crucial role in deriving the underapplicational effect.

I have mentioned above that r-Deletion is also visibly active in the overapplicative type of reduplication (see §5.4.1.2). The overapplication of r-Deletion is the result of a conspiracy to satisfy BR-IDENT, particularly ANCHOR-RIGHT, which demands that the right peripheral edge of the base and the right peripheral edge of the reduplicant must be in correspondence.

The hierarchy of constraints that has been established for accounting for the overapplication of r-deletion is ANCHOR-RIGHT, PHONO-CONS >> IO-FAITH. For convenience, I represent the effects of this ranking in the tableau below.

(294) Overapplication of r-Deletion

/ukor+RED/	ANCHOR-RIGHT	PHONO-CONS	IO-FAITH
a. <u>u.kor.ru.kor</u>		*!	
b. <u>u.kor.ru.ko:</u>	*!		
c. <u>u.ko:u.ko:</u>			*

As mentioned, for underapplication to be visibly active there must be a constraint C' that blocks the regular alternation of r-Deletion. In accordance with the general ranking hierarchy in (293), C' must be ranked higher than PHONO-CONS. Without C' the ranking in (294) would yield an overapplicative effect if it were to apply to the data in (292).

(295) Overapplication of r-Deletion — incorrect result

/bəsar+RED+an/	ANCHOR-RIGHT	PHONO-CONS	IO-FAITH
a. ☺ <u>bəsar-bəsarran</u>		*!	
b. <u>bəsa:-bəsar</u> an	*!		*
c. ☹ <u>*bəsa:-bəsa</u> an			*

The normal application candidate, (295b), is miss-anchored, since the right peripheral segment of the reduplicant does not correspond to the right peripheral segment of the base. The underapplication candidate, (295a), is well-anchored, even though the correspondence relation between the base and the reduplicant is represented by a single [r] and a geminate [rr], respectively. As mentioned, ANCHOR-RIGHT is fully satisfied as long as the two segments are in correspondence. The relevant constraint that is violated here is INTEGRITY-BR<sub>X</sub> (270b), which militates against the base having multiple X correspondents in the reduplicant. However, this violation is irrelevant, since INTEGRITY-BR<sub>X</sub> is lower ranked in the hierarchy (271).

Despite the fact that it is well-anchored, candidate (295a) is defective, since it contains a forbidden coda [r] segment, an instance of violation of PHONO-CONS. Form (295c), the overapplicative candidate, is incorrectly chosen as the winner because it survives both ANCHOR-RIGHT and PHONO-CONS, at the expense of violating IO-FAITH.

Observe that, in satisfying ANCHOR-RIGHT, the rightmost member of candidate (295c) has no syllable onset. This is a serious violation of ONSET, as the language disfavours onsetless syllables. Thus, it is apparent that ONSET must be the blocking constraint referred to as C' in this context. As suggested in (293), this constraint must be ranked above PHONO-CONS, and the ranking is now ANCHOR-RIGHT, ONSET >> PHONO-CONS >> IO-FAITH.

(296) Underapplication of Malay r-Deletion — correct result

/bəsar+RED+an/	ANCHOR- RIGHT	ONSET	PHONO- CONS	IO- FAITH
a. <i>ʔbəsar-bəsarran</i>			*	
b. <i>bəsa:-bəsar<span style="text-decoration: underline;">ran</span></i>	*!			*
c. <i>bəsa:-bəsa<span style="text-decoration: underline;">:an</span></i>		*!		*

As shown, the higher ranked ONSET rules out the overapplicative candidate (296c) and favours the underapplicative candidate (296a). Interestingly, the conspiracy to satisfy ONSET at the same time drives the effect of overapplication in other situations, such as the overcopying of the r-final prefix in [bərikot-rikot]. ONSET also triggers the process of Glottal Epenthesis in the candidate that undergoes overapplication of r-Deletion, such as in [u.ko:ʔ u.ko:] in (294).

In sum, similarly to the case of overapplication and normal application of Nasal Coalescence discussed earlier, the overapplication and underapplication of r-Deletion is regulated by a single constraint hierarchy: ANCHOR-RIGHT, ONSET >> PHONO-CONS >> IO-FAITH.

Let us now see how the reduplicative pattern in (292) is captured under the Global Theoretic approach. Before we proceed, it must be mentioned that in Farid's (1980) analysis the occurrence of the final [r] in the leftmost member of the reduplicated forms is said to be optional. This optionality not only applies to /r/, but to any other sonorants occurring in the same environment. Farid (1980:104) notes:

This optionality of either retaining or dropping the final sonorant of the leftmost member of reduplicated forms, such as *diʔaja(r)-ajari*, *menika(m)-nikami*, *dipuku(l)-pukuli*, etc., is common phenomenon in JM, and is especially realised in the speech of my informant. The final sonorant of the leftmost member tends to be dropped in a faster rate of speech.

In order to account for the optional occurrence of sonorant segments in the leftmost member of the reduplicated forms, Farid (1980:106) makes two crucial assumptions: (i) any optionality of occurrence involving one or more segments in reduplicated forms is due to the reduplication process itself, and not to the application of any phonological rules, (ii) whenever there is a case involving optionality, this is manifested in the copied, and not the original, stem.

Recall the case of overcopying of prefix-final C in §5.4.1.5, which is also regarded as an optional process in Farid's (1980) study. This reduplicative phenomenon is accounted for by making the morphological rule of reduplication a global rule. By being global, it has the power to look back and copy the stem.

Following the same line of argument, the global rule of reduplication scans the input strings and then optionally copies the optional sonorant segment. For instance, in the reduplicative input /bəsar+bəsar+an/, the reduplication rule looks back and copies the segment [r] of the base, to derive the form [bəsa(r)-bəsaran]. As I commented earlier, allowing morphological rules like reduplication to be global is too powerful, because it will generate reduplicated forms that are not attested in the language.



If we regard the occurrence of [r] (in fact all sonorants) in the leftmost member of the reduplicated forms as obligatory, indeed the situation in the variety discussed here, the underapplication of r-Deletion in these circumstances can be captured under the global rule approach by not allowing the rule to apply. A rule that fails to apply is formulated as: X (and X') → Y if X (and X') / A \_\_\_ B (Wilbur 1973a).

However, as we have seen earlier, r-Deletion is also visibly active in overapplication, in particular in reduplicated forms that involve vowel-initial stems, such as [uko:-ʔuko:] and [adʒa:-ʔadʒa:], which are derived from /ukor/ 'to measure' and /adʒar/ 'to teach'. By contrast, in such cases, the rule of r-Deletion has to be specified as an overapplying rule.

In short, Malay r-Deletion manifests itself in two types of reduplicative patterns. It overapplies in bare root reduplication if the root is vowel-initial, and underapplies in the suffixed root reduplication. When the same rule can apply in two different environments, its application as a global rule is indeterminable, and therefore the generalisations in those forms cannot be captured.

## 5.5 Conclusion

Malay reduplication includes three phonological reduplicative patterns, namely, overapplication, underapplication and normal application. The rule-based Global Theoretic approach, which involves specifying for each rule whether it overapplies, underapplies or applies normally, is inadequate both descriptively and explanatorily. Descriptively, the theory fails to account for how Nasal Coalescence and r-Deletion in Malay can overapply in some environments, and apply normally and underapply in others. Explanatorily, it cannot formalise the conditions that determine such reduplicative effects.

Under Correspondence Theory, which is set within the constraint-based-approach of OT, these reduplicative phenomena can be integrated into a single process. That is, they can be governed by a single general ranking schema. Correspondence Theory thus provides a unified framework to capture all of those reduplicative patterns.

For convenience of reference, I briefly tabulate the subhierarchical rankings significant in the general reduplicative patterns of Malay reduplication.

### (297) Constraint Rankings

Ranking	Effects
PHONO-CONS (*NÇ) >> IO-FAITH >> IDENT-BR[Nasal] (250)	Overapplication of Nasal Coalescence where the target of the phonological process is found in the base, and the phonological effect is then transmitted to the reduplicant.
PHONO-CONS (*NV <sub>ORAL</sub> ) >> IO-FAITH >> IDENT-BR[Nasal] (262)	Interactional overapplication of Vowel Nasalisation where the base triggers and copies the same phonological alternation.
PHONO-CONS (*NÇ) >> IO-FAITH >> IDENT-BR[Nasal] (279)	Normal application of Nasal Coalescence and Vowel Nasalisation where the target of the phonological process is found in the reduplicant, and the phonological effect is not transmitted to the base.

ANCHOR-RIGHT, PHONO CONS (ALIGN-RHOTIC) >>IO-FAITH (256)	Overapplication of r-Deletion where the reduplicant becomes the target, and the phonological effect is carried to the base.
ANCHOR-RIGHT, ONSET>> PHONO-CONS (ALIGN-RHOTIC) >>IO-FAITH (296)	Underapplication of r-Deletion where the base fails to undergo the regular alternation, although its triggering condition is fully met.
IDENT-BR[Place], PHONO-CONS (NO-LIGHT [a])>>IO-FAITH (259)	Overapplication of Vowel Debuccalisation where the alternation in the reduplicant is carried to the base.
ANCHOR-RIGHT, ONSET>> IO-FAITH>>IDENT-BR[F]>> R=ROOT>>MAX-BR (273)	Overcopying of prefix-final C to provide onset to the reduplicant.

# 6 *Conclusion*

---

## 6.1 Conclusion

This chapter concludes the discussion and analysis on Malay by recapitulating the substantial findings of this study. It also addresses some important regularities in partial reduplication and Nasal Coalescence that have not been scrutinised here, but are interesting enough to be explored in future research.

Malay is a language with a basic syllable structure (C)V(C), allowing only a single segment to occupy each syllabic constituent. Since vowels are more sonorous than consonants, they make more harmonic nuclei and less harmonic margins. Within the vowels, the high vocoids are less sonorous, and they can potentially qualify as margins. In previous studies, high vowels in the margins are referred to as 'glides', conventionally represented as [j, w], and claimed to be members of the underlying inventory of contrasting phonological segments in the language (Abdullah 1974; Yunus 1980; Farid 1980; Teoh 1994).

By contrast, I argue that there are no such segments as 'glides' in Malay, as there are evidently no phonological grounds for establishing them. It is apparent that there is no difference in phonological substance between 'glides' and high vowels, the difference between the two arising exclusively from their respective syllabification.

Malay generally requires that every surface syllable have a single onset, implying that the syllable structure constraint ONSET is highly ranked in the language. Despite the fact that onsets are strongly preferred, there are two instances where a surface syllable can be onsetless, namely, in word-initial and root-internal positions. The regular rule of Glottal Epenthesis never applies in these environments. The violation of ONSET is admissible here to assure the satisfaction of two undominated constraints in the hierarchy, namely, ALIGN-LEFT and ROOTCONTIG (see §2.4), which militate against segmental epenthesis word-initially and root-internally, respectively.

Another significant consequence of ROOTCONTIG is the ban of root-internal deletion. Visibly active rules such as Nasal Deletion and r-Deletion, which are triggered by the OCP and CODA COND constraints, are opaque root-internally. The effect of phonological opacity within the root domain is easy to observe, but it has been overlooked and misinterpreted in the previous analyses.

Although Malay may have single-member codas, there is a restriction in the language which prohibits a small class of consonants in that position. This prohibition is due to the syllable structure constraint CODA COND. I have reinterpreted and reformalised this constraint in terms of Itô and Mester's (1994) alignment constraint. I have argued that

Malay has four constraints subsumed under the CODA COND constraint family, namely, ALIGN-STOP(K), ALIGN-OBST, ALIGN-RHOTIC and ALIGN-NASAL (see §2.5). These constraints are distinct, and therefore they are separately ranked in the constraint hierarchy.

The effects of CODA COND constraints ALIGN-STOP (K), ALIGN-OBST, ALIGN-RHOTIC and ALIGN-NASAL are represented in four phonological phenomena called Debuccalisation, Obstruent Devoicing, r-Deletion and Nasal Assimilation, respectively. The aspects of Malay phonology governed and conditioned by syllable structure and syllabification have been discussed in Chapter 2.

Chapters 3 and 4 have offered an OT account of the interface between phonology and morphology in suffixation and prefixation, respectively. Given the facts of Malay, it is evident that the morphophonological behaviour of suffixation is quite distinct from prefixation both in character and in degree of generality. Processes that are visibly active at the prefix boundary are generally inapplicable at the suffix boundary, and vice versa. For instance, Nasal Assimilation and Nasal Coalescence regularly apply in prefixation, but not in suffixation. V-Gemination and C-Gemination, on the other hand, are active in suffixation, but not in prefixation.

In the present study, the asymmetry between suffixation and prefixation is accounted for as a consequence of a candidate output's need to best satisfy the constraint hierarchy, particularly with respect to the prosody-morphology interface of the alignment constraints ALIGN-RIGHT and ALIGN-PREF, which govern the interactions at the suffix boundary and prefix boundary, respectively.

ALIGN-RIGHT and ALIGN-PREF are two distinct constraints of the GENERALISED ALIGNMENT constraint family, and therefore they are also separately ranked in the hierarchy - ALIGN-RIGHT is ranked higher than ALIGN-PREF. The transparency of Nasal Assimilation (driven by ALIGN-NASAL) and Nasal Coalescence (driven by \*NÇ) in prefixation and their opacity effects in suffixation can be straightforwardly explained under the hierarchical ranking ALIGN-RIGHT >> ALIGN-NASAL, \*NÇ >> ALIGN-PREF (see §4.5).

ALIGN-RIGHT and ALIGN-PREF are also distinguishable with respect to the notion of 'crispness' alignment of Itô and Mester (1994). ALIGN-RIGHT is interpreted as a 'noncrisp' alignment constraint, whereby a doubly-linked structure is not reckoned as an alignment violation, whereas ALIGN-PREF is a 'crisp' constraint requiring a sharply defined morpheme edge alignment. This directly offers an explanation as to why the phenomena of V-Gemination and C-Gemination are applicable at the suffix boundary, but not at the prefix boundary.

In Chapter 5 I demonstrated that Correspondence Theory (McCarthy & Prince 1994, 1995b), set within the parallel constraint-based approach of Optimality Theory, can adequately account for all the Malay reduplicative patterns under investigation. Over-, under- and normal application are regulated under a single schema of the language's constraint ranking hierarchy. All the possible output candidates are evaluated symmetrically and simultaneously with respect to this ranking. This suggests that neither the base nor the reduplicant has serial priority in the interaction, the emergence of each reduplication pattern being a consequence of best satisfaction of this constraint hierarchy.

I have argued that Malay reduplication is suffixal, and therefore subject to ALIGN-RIGHT, a prosody-morphology interface constraint that plays a crucial role in suffixation. Obedience to ALIGN-RIGHT readily explains why the reduplicated form is also opaque to Nasal Assimilation and Nasal Coalescence.

The interaction between the phonological processes of Nasal Harmony (Nasal Coalescence and Vowel Nasalisation) and reduplication gives rise to two different patterns of reduplicative phonology, namely, overapplication and normal application. Under the Global Theoretic approach, this fact is very difficult, if not impossible, to account for, whereas under Correspondence Theory the effects of over- and normal application are jointly governed by a single ranking: PHONO-CONS >> IO-FAITH >> IDENT-BR[Nasal] (see §5.4.2). As expected, the surface form is always the candidate that best satisfies this ranking hierarchy.

Another phonological process that involves two different patterns of reduplicative phonology is r-Deletion. This process overapplies in bare root reduplication, but underapplies in suffixed root reduplication. Similarly to the case of the over- and normal application of Nasal Coalescence, over- and underapplication of r-Deletion is regulated by a single constraint hierarchy: ANCHOR-RIGHT, ONSET >> PHONO-CONS >> IO-FAITH, again the emergence of each pattern being a consequence of the best satisfaction of this constraint hierarchy.

## 6.2 Concluding remarks

The analysis I have presented thus far satisfactorily accounts for the relevant data that come under scrutiny in the present study. There are, however, a number of puzzling issues with respect to the phonology of partial reduplication and the phonology of Nasal Coalescence that I am unable to explore due to limitations of space and time. It is pertinent to raise them here for future research.

### 6.2.1 *Partial reduplication*

I have noted that, in colloquial Malay and most of the Peninsular Malay dialects (Abdullah 1974; Hendon 1966; Farid 1980; Zaharani 1991), the so-called partial reduplication is widely used as a variant of the total copying reduplication. Some relevant examples are as follows:

(298)	Root	Partial reduplication	Total reduplication	
	buwat	bəʔbuwat	buwat-buwat	'make, do'
	gəlap	gəʔgəlap	gəlap-gəlap	'dark'
	bajaŋ	bəmbajaŋ	bajaŋ-bajaŋ	'shadow'
	pətaŋ	pəmpətaŋ	pətaŋ-pətaŋ	'evening'
	dalam	dəndalam	dalam-dalam	'deep'
	tanām	təntanām	tanām-tanām	'bury'
	kawan	kəŋkawan	kawan-kawan	'friend'
	dʒalan	dʒəŋdʒalan	dʒalan-dʒalan	'walk'
	sukə	səsukə	sukə-sukə	'like'
	satu	səsatu	satu-satu	'one'
	māti	məməti	māti-māti	'die'

The observations that are manifested in the examples given can be summarised as follows: (i) the reduplicative morpheme RED is a prefix; (ii) the reduplicant surfaces as a light syllable CV when the base is V-final, and as a heavy syllable CVC when the base is C-final; (iii) the V-segment in the reduplicant is prespecified with a vowel schwa [ə]; and (iv) the C-final segment in the reduplicant which surfaces as homorganic nasal or a glottal stop is a partial copy of the final consonant of the base.

Considering the analysis developed thus far, these observations pose some fundamental challenges. First, in partial reduplication the regularities do not conform to the general properties of the phonology and the general properties of the interface of the phonology and the morphology in the language. For instance, the reduplicative prefix RED does not undergo the regular Nasal Coalescence rule which is visibly active in the ordinary prefixation. The Debuccalisation of /p/ and /t/ never applies in environments other than the reduplicative morpheme.

Second, the segmental make-up of the reduplicative affix which is determined by the shape of the base seemingly violates the standard assumptions about the consistency of the prosodic template of the reduplicative morpheme RED. Third, the occurrence of the fixed-vowel schwa in the reduplicative prefix violates a DEP-BR constraint, which requires that every element of the reduplicant must have a correspondent in the base. Fourth, the satisfaction of the CVC template of the morpheme RED involves copying of discontinuous materials of the base, and this violates the CONTIGUITY constraint, which forbids 'skipping' of elements in the base (cf. McCarthy & Prince 1994, 1995b).

Another sub-class of partial reduplication involves copying the final syllable of the base (Abdullah 1974:45; Farid 1980:69). Here too, the reduplicative morpheme RED must be analysed as a prefix, and its skeletal template can be either CV or CVC, as the following examples illustrate.

(299)	Root	Partial reduplication	Total reduplication	
	budaʔ	daʔbudaʔ	budaʔ-budaʔ	'children'
	hitam	tamhitam	hitam-hitam	'black'
	rumāh	māhrumāh	rumāh-rumāh	'house'
	gəlap	lapgəlap	gəlap-gəlap	'dark'
	baraŋ	raŋbaraŋ	baraŋ-baraŋ	'thing'
	pətaŋ	taŋpətaŋ	pətaŋ-pətaŋ	'evening'
	tikam	kamtikam	tikam-tikam	'stab'
	bəli	libəli	bəli-bəli	'buy'
	katə	təkətə	katə-katə	'speak'

Moreover, in this partial reduplication the regularities do not conform with the general properties of the phonology and the general properties of the interface between the phonology and morphology of the language. For instance, the reduplicative prefix RED does not undergo the regular Nasal Assimilation and Nasal Coalescence rules which are visibly active in ordinary prefixation.

Second, the process of copying the final syllable of the base violates the formal constraint ANCHOR (246), particularly ANCHOR-LEFT, which can be defined as follows: the left peripheral element of Reduplicant corresponds to the left peripheral element of Base, if Reduplicant is to the left of Base (prefixing reduplication) (cf. McCarthy & Prince 1994).

In sum, the regularities of partial reduplication exemplified in (298) and (299) are incompatible with the general properties of Malay phonology and the general properties of the interface between phonology and morphology of the language. The actual output violates significant constraints such as ANCHOR, CONTIGUITY, \*NÇ and ALIGN-NASAL. What motivates such violations needs to be explored in future research.

### 6.2.2 Nasal Coalescence

The phonology of Nasal Coalescence in Malay is very intricate. As noted in chapter four, the voiceless palatal obstruent /tʃ/ is excluded from this rule. This peculiar behaviour of /tʃ/ makes it difficult to capture the natural class of the segments that are involved in the process of Nasal Coalescence. The second issue is, why does /s/ behave like an underlying palatal instead of an alveolar? The third problem is the opacity of Nasal Coalescence at the prefix-prefix juncture.

It was originally suggested by Farid (1980:64), and subsequently accepted by others (cf. Kroeger 1988; Durand 1987; Pater 1999), that the exclusion of /tʃ/ from Nasal Coalescence is due to a transderivational constraint which serves to avoid homophony of prefixed forms of stems with initial /tʃ/ (i.e. /məŋ+tʃolek/ 'to kidnap (active)' surfaces as [məŋtʃoleʔ], not \*[məŋðoleʔ]) and initial /s/ (i.e. /məŋ+solek/ 'to make-up (active)' surfaces as [məŋðoleʔ]). It is argued that if both /tʃ/ and /s/ were to become /ɲ/, then the surface output of two distinct underlying forms would be ambiguous.

Given the facts of Malay, this generalisation is evidently not legitimate, because homophony is quite common in this language. For instance, there is homophony between the suffixed forms of the C-initial suffix /-kan/ and the V-initial suffix /-an/ in forms such as /masak+an/ 'cooking, dish' and /masak+kan/ 'cook (imperative)', both surfacing as [māsaʔkan]. Homophony between prefixed forms is also well attested in the language.

#### (300) a. Homophony between /k-/ and V-initial stems

/məŋ+ukor/	[məŋũko:]	'to measure (active)'
/məŋ+kukor/	[məŋũko:]	'to scrape (active)'
/məŋ+urus+kan/	[məŋũruskan]	'to cause to manage for'
/məŋ+kurus+kan/	[məŋũruskan]	'to cause to be thin'
/məŋ+aual+kan/	[məŋãwãlkan]	'to cause to give prior attention'
/məŋ+kaual+kan/	[məŋãwãlkan]	'to cause to guard for'

#### b. Homophony between voiceless stop and nasal initial stems

/məŋ+pasak/	[mə̃māsaʔ]	'to push (active)'
/məŋ+masak/	[mə̃māsaʔ]	'to cook (active)'
/pəŋ+palu/	[pə̃mālu]	'one who hits'
/pəŋ+malu/	[pə̃mālu]	'one who is shy'
/pəŋ+tahu/	[pə̃nāhũ]	'one who knows'
/pəŋ+nahu/	[pə̃nāhũ]	'grammarian'
/pəŋ+saman/	[pə̃nāmān]	'one who gives summons'
/pəŋ+ɲaman/	[pə̃nāmān]	'something that comforts'



The third outstanding issue is the peculiar behaviour of /s/ with respect to the phonology of Nasal Coalescence. This process involves the replacement of /s/ by a palatal nasal [ɲ], instead of the expected [n]. Due to this fact, Farid (1980:5) treats /s/ as an underlying alveopalatal voiceless fricative (cf. Mester 1986). Kroeger (1988), on the other hand, analyses /s/ as a palatal stop /k'/, seemingly the historical reflex of a voiceless palatal stop. This analysis makes Nasal Coalescence a highly natural and regular rule, as the segments affected are now the voiceless stops /p, t, k', k/. However, this approach is excessively abstract, because it necessitates a rule of absolute neutralisation: /k'/ → [s]. In addition, it is also badly motivated, because an underlying /s/ in assimilated loan words evidently undergoes Nasal Coalescence, as can be seen below.

(301)	/məŋ+simen/	[mãŋĩmẽn]	'to cement (active)'
	/məŋ+saman/	[mãŋãmãn]	'to summon (active)'
	/məŋ+saen/	[mãŋãẽn]	'to sign (active)'
	/məŋ+sətem/	[mãŋãtem]	'to put a stem (active)'
	/məŋ+səkop/	[mãŋãkop]	'to scoop (active)'

The next puzzling issue with respect to Nasal Coalescence is its contradictory effects at the prefix+prefix juncture. The general claim that the prefix+prefix boundary is impermeable to Nasal Coalescence (cf. Asmah 1986; Abdullah 1987; Kroeger 1988; Pater 1999) is oversimplified. There are cases where this process regularly applies in this environment, as the following examples illustrate.

(302)	/məŋ+pər+satu+kan/	[mãm̩pəsaturan]	'to unite'
	/pəŋ+pər+satu+an/	[pəm̩əsatuwan]	'unification'
	/məŋ+pər+badan+kan/	[mãm̩pəbadankan]	'to organise'
	/pəŋ+pər+badan+an/	[pəm̩əbadannãn]	'organisation'
	/məŋ+tər+balek+kan/	[mãm̩təbaleʔkan]	'to turn over'
	/məŋ+pəŋ+kərusi+kan/	[mãm̩pəŋərusikan]	'to chair (a meeting)'
	/pəŋ+kə+tahu+an/	[pəŋətahuwãn]	'knowledge'
	/məŋ+kə+tua+i/	[mãm̩ətuwaʔi]	'to head'
	/pəŋ+sə+ragam+an/	[pəŋəragammãn]	'uniformity'
	/məŋ+sə+tudzu+i/	[mãm̩ətudzuwi]	'to agree'

The generalisations that can be observed here are: (i) the process of Nasal Coalescence is opaque if /məŋ-/ is followed by a historically heavy syllable prefix (i.e. /pər-/ , /tər-/), and transparent if the prefix is light (i.e. /sə-/ , /kə-/), and (ii) the process is always transparent with the nasal prefix /pəŋ-/ (cf. Zaharani 1993). All the issues that I have brought up here require an explanation. Whether or not OT can account for the regularities observed is a question that only future research can answer.

# References

---

- Abdullah Hassan, 1974, *The morphology of Malay*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- 1987, *Penerbitan kata dalam bahasa Melayu*. Petaling Jaya: Fajar Bakti.
- 1993, *Kamus ejaan dan sebutan bahasa Melayu*. Petaling Jaya: Longman.
- Aronoff, Mark, 1976, *Word formation in generative grammar*. Cambridge, MA: MIT Press.
- 1988, Head operations and strata in reduplication: a linear treatment. *Yearbook of morphology* 1:1–15.
- Asmah Haji Omar, 1975, *Essays on Malaysian linguistics*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- 1977, *The phonological diversity of the Malay dialects*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- 1986, *Nahu Melayu mutakhir*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- 1993, *Susur galur bahasa Melayu*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Archangeli, Diana and Douglas Pulleyblank, 1994, *Grounded phonology*. Cambridge, MA: MIT Press.
- Bador, Z.A. 1964, Word forms in the Malay of Negeri Sembilan. MA thesis, University of London.
- Bagemihl, Bruce, 1995, Language games and related areas. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Benua, Laura, 1995, Identity effects in morphological truncation. In Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, eds *University of Massachusetts occasional papers in linguistics* 18: *Papers in optimality theory*. Amherst, MA: Graduate Linguistic Student Association.
- Bichakjian, B., 1986, When do lengthened vowels become long? Evidence from Latin and French. In L. Wetzels and E. Sezer, eds *Studies in compensatory lengthening*. Dordrecht: Foris.
- Bird, Steven, 1990, Constraint base phonology. PhD dissertation, Edinburgh University.
- 1995, *Computational phonology: a constraint-based approach*. Cambridge: Cambridge University Press.
- Blevins, Juliette, 1995, The syllable in phonological theory. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Booij, Geert, 1997, Non-derivational phonology meets lexical phonology. In Iggy Roca, ed. *Derivations and constraints in phonology*. Oxford: Clarendon Press.

- Broselow, Ellen, 1995, Skeletal positions and moras. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Broselow, Ellen and John J. McCarthy, 1983, A theory of internal reduplication. *The Linguistic Review* 3:25–88.
- Buckley, Eugene, 1996, Constraint domains in Kashaya. In José Camacho, Lina Choueiri and Maki Watanabe, eds *The proceedings of the Fourteenth West Coast Conference on Formal Linguistics*. Stanford: CSLI Publications.
- Carrier-Duncan, Jill, 1984, Some problems with prosodic accounts of reduplication. In Mark Aronoff and Richard Oehrle, eds *Language sound structure*, 260–286. Cambridge, MA: MIT Press.
- Chomsky, Noam and Morris Halle, 1968, *The sound pattern of English*. Cambridge, MA: MIT Press.
- Clements, George N., 1985, The geometry of phonological features. *Phonology Yearbook* 2:225–252.
- Clements, George N. and Elizabeth V. Hume, 1995, The internal organisation of speech sounds. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Clements, George N. and S. Jay Keyser, 1983, *CV phonology: a generative theory of the syllable*. Cambridge, MA: MIT Press.
- Cohn, Abigail C., 1989, Stress in Indonesian and bracketing paradoxes. *Natural Language and Linguistic Theory* 7:167–216.
- 1993, The initial dactyl effect in Indonesian and the status of degenerate feet. *Linguistic Inquiry* 24:372–381.
- Cohn, Abigail C. and John J. McCarthy, 1994, Alignment and parallelism in Indonesian prosody. MS, Cornell University, Ithaca, NY, and University of Massachusetts, Amherst.
- Cole, Jennifer, 1995, The cycle in phonology. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Collins, James T., 1986, Dialek Melayu Selangor: tinjauan di Jugra. *Jurnal Persatuan Linguistik* 2:74–94.
- Dempwolff, Otto, 1934–38, *Vergleichende Lautlehre des Austronesischen Wortschatzes*. Liechtenstein: Kraus.
- Durand, Jacques, 1987, On the phonological status of glides: the evidence from Malay. In John Anderson and Jacques Durand, eds *Explorations in dependency phonology*. Dordrecht: Foris.
- Downing, Laura J., 1994, SiSwati verbal reduplication and the theory of generalised alignment. In Mercè González, ed. *Proceedings of the North East Linguistic Society* 24, 81–95. Amherst, MA: Graduate Linguistic Student Association.
- Farid M. Onn., 1980, *Aspects of Malay phonology and morphology: a generative approach*. Bangi: Universiti Kebangsaan Malaysia.
- Goldsmith, John A., 1976, Autosegmental phonology. PhD dissertation, MIT. (Published in 1979. New York: Garland.)
- 1990, *Autosegmental and metrical phonology*. Oxford: Basil Blackwell.
- 1993, Harmonic phonology. In John A. Goldsmith, ed. *The last phonological rule*. Chicago: University of Chicago Press.
- 1995, Phonological theory. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Guerssel, Mohamed, 1978, A condition on assimilation rules. *Linguistic Analysis* 4:225–254.

- Hall, J. Christopher, 1992, *Morphology and mind: a unified approach to explanation in linguistics*. London: Routledge.
- Halle, Morris, 1995, Feature geometry and feature spreading. *Linguistic Inquiry* 26(1):1–46.
- Hashim Hj. Musa, 1974, Morfemik dialek Melayu Kelantan. MA thesis, University of Malaya, Kuala Lumpur.
- 1993, *Binaan dan fungsi perkataan dalam bahasa Melayu: suatu huraian dari sudut tatabahasa generatif*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Hayes, Bruce, 1986a, Inalterability in CV phonology. *Language* 62:321–351.
- 1986b, Assimilation as spreading in Toba Batak. *Linguistic Inquiry* 17:467–500.
- 1989, Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20:253–306.
- Hendon, Rufus S., 1966, *The phonology and morphology of Ulu Muar Malay*. Yale Publications in Anthropology 70, Yale University.
- Holton, David B., 1995, Assimilation and dissimilation of Sundanese liquids. In Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, eds *University of Massachusetts occasional papers in linguistics* 18: *Papers in optimality theory*. Amherst, MA: Graduate Linguistic Student Association.
- Hyman, Larry, 1975, *Phonology: theory and analysis*. New York: Holt, Rinehart and Winston.
- 1985, *A theory of phonological weight*. Dordrecht: Foris.
- Ingria, R., 1980, Compensatory lengthening as a metrical phenomenon. *Linguistic Inquiry* 11:465–495.
- Inkelas, Sharon, 1990, *Prosodic constituency in the lexicon*. New York: Garland Publishing, Inc.
- Inkelas, Sharon, 1995, The consequences of optimization for underspecification. In Jill N. Beckman, ed. *Proceedings of the North East Linguistic Society* 25, 287–302. Pennsylvania: University of Pennsylvania.
- Itô, Junko, 1986, Syllable theory in prosodic phonology. PhD dissertation, University of Massachusetts, Amherst.
- 1989, A prosodic theory of epenthesis. *Natural language and linguistic theory* 7:217–259.
- Itô, Junko and R. Armin Mester, 1986, The phonology of voicing in Japanese. *Linguistic Inquiry* 17:49–73.
- 1993, Licensed segments and safe paths. In Carole Paradis and Darlene LaCharité, eds *Constraint-based theories in multilinear phonology*. *Canadian Journal of Linguistics* 38:197–213.
- 1994, Reflections on coda cond and alignment. In Jason Merchant, Jaye Padgett and Rachel Walker, eds *Phonology at Santa Cruz*, vol. 3. Santa Cruz: University of California, Santa Cruz.
- Itô, Junko, R. Armin Mester and Jaye Padgett, 1995, Licencing and underspecification in optimality theory. *Linguistic Inquiry* 26:571–614.
- Kahn, Daniel, 1976, Syllable-based generalizations in English phonology. PhD dissertation, MIT. Distributed by Indiana University Linguistics Club.
- Kari, James, 1973, Navajo verb prefix phonology. PhD dissertation, University of New Mexico. (Published in 1976. New York: Garland.)
- Karttunen, Lauri, 1993, Finite-state constraints. In John A. Goldsmith, ed. *The last phonological rule*, 173–194. Chicago: University of Chicago Press.

- Kaye, Jonathan, Jean Lowenstamm and Jean-Roger Vergnaud, 1985, The internal structure of phonological elements: a theory of charm and government. *Phonology Yearbook* 2:305–328.
- Keer, Edward, 1995, Glide insertion. MS. Rutgers University, New Brunswick, NJ.
- Kenstowicz, Michael, 1994a, *Phonology in generative grammar*. Cambridge: Blackwell.
- 1994b, Sonority-driven stress. MS. MIT.
- 1994c, Syllabification in Chukchee: a constraint-based analysis. In Alice Davison, Nicole Maier, Glaucia Silva and Wan Su Yan, eds *Proceedings of the Formal Linguistics Society of Mid-America* 4, 160–181. Iowa City: Department of Linguistics, University of Iowa.
- 1995, Cyclic vs. noncyclic constraint evaluation. *Phonology* 12(3):397–436.
- Kenstowicz, Michael and Charles Pyle, 1973, On the phonological integrity of geminate clusters. In Michael Kenstowicz and Charles Kisserberth, eds *Issues in phonological theory*. The Hague: Mouton.
- Kiparsky, Paul, 1982, Lexical phonology and morphology. In I.S. Yang, ed. *Linguistics in the morning calm*, 3–91. Seoul: Hanshin.
- Koskeniemi, Kimmo, 1983, *Two-level morphology: a general computational model for word-form recognition and production*. Publication No. 11, Department of General Linguistics, University of Helsinki.
- Kroeger, Paul. R., 1988, Sonority, strength, and the Malayo-Javanic nasal prefixes. MS. University of Stanford.
- Lakoff, George, 1993, Cognitive phonology. In John A. Goldsmith, ed. *The last phonological rule*, 117–145. Chicago: University of Chicago Press.
- Lamontagne, Greg and Keren Rice, 1995, A correspondence account of coalescence. In Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, eds *University of Massachusetts occasional papers in linguistics* 18: *Papers in optimality theory*. Amherst, MA: Graduate Linguistic Student Association.
- Lass, Roger, 1976, *English phonology and phonological theory*. Cambridge: Cambridge University Press.
- 1984, *Phonology: an introduction to basic concepts*. Cambridge: Cambridge University Press.
- Leben, William, 1973, Suprasegmental phonology. PhD dissertation, MIT. Distributed by Indiana Linguistics Club, Bloomington.
- Levin, Juliette, 1984, Conditions on syllable structure and categories in Klamath phonology. In Mark Cobler, Susannah MacKaye, Michael T. Wescoat, eds *Proceedings of the West Coast Conference on Formal Linguistics*, vol. 3. Stanford: The Stanford Linguistics Association.
- 1985, A metrical theory of syllabicity. PhD dissertation, MIT.
- Lombardi, Linda, 1991, Laryngeal features and laryngeal neutralisation. PhD dissertation, University of Massachusetts, Amherst.
- 1995, Laryngeal neutralization and alignment. In Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, eds *University of Massachusetts occasional papers in linguistics* 18: *Papers in optimality theory*. Amherst, MA: Graduate Linguistic Student Association.
- Lowenstamm, Jean and Jonathan Kaye, 1986, Compensatory lengthening in Tiberian Hebrew. In L. Wetzels and E. Sezer, eds *Studies in compensatory lengthening*. Dordrecht: Foris.

- Mascaró, J., 1976, Catalan phonology and the phonological cycle. PhD dissertation, MIT. Distributed by Indiana Linguistics Club.
- Marantz, Alec, 1982, Re reduplication. *Linguistic Inquiry* 13:435–482.
- 1987, Phonologically induced bracketing paradoxes in full morpheme reduplication. In Megan Crowhurst, ed. *Proceedings of the Sixth West Coast Conference on Formal Linguistics*, 203–212. Stanford, CA: Stanford Linguistics Association.
- Marlett, Stephen and Joseph Stemberger, 1983, Empty consonants in Seri. *Linguistic Inquiry* 14:617–639.
- McCarthy, John J., 1986, OCP effects: gemination and antigemination. *Linguistic Inquiry* 17:207–263.
- 1988, Feature geometry and dependency: a review. *Phonetica* 43:84–108.
- 1993a, A case of surface constraint violation. *Canadian Journal of Linguistics/Revue Canadienne de Linguistique* 38(2):169–195.
- 1993b, The parallel advantage: containment, consistency and alignment. Handout of talk presented at Rutgers Optimality Workshop I, Rutgers University.
- 1994, Remarks on phonological opacity in optimality theory. MS, University of Massachusetts, Amherst.
- 1995, Extensions of faithfulness: Rotuman revisited. MS, University of Massachusetts, Amherst.
- McCarthy, John J. and Alan M. Prince, 1986, Prosodic morphology. MS, University of Massachusetts, Amherst, and Brandeis University, Waltham, Mass.
- 1988, Quantitative transfer in reduplicative and templatic morphology. In *Linguistics in the morning calm 2*, ed. Linguistic Society of Korea. Seoul: Hanshin Publishing Co. 3–35.
- 1990a, Foot and word in prosodic morphology: the Arabic broken plural. *Natural language and linguistic theory* 8:177–208.
- 1990b, Prosodic morphology and templatic morphology. In M. Eid and John J. McCarthy, eds *Perspectives on Arabic linguistics 2: Papers from the Second Annual Symposium on Arabic Linguistics*, 1–54. Amsterdam: John Benjamins.
- 1993a, Prosodic morphology 1: constraint interaction and satisfaction. MS, University of Massachusetts, Amherst, and Rutgers University, New Brunswick. [To appear Cambridge, MA: MIT Press.]
- 1993b, Generalized alignment. In Geert Booij and Jaap van Marle, eds *Yearbook of morphology* 1993, 79–153. Dordrecht: Kluwer.
- 1994, The emergence of the unmarked: optimality in prosodic morphology. In Mercè González, ed. *Proceedings of the North East linguistic society* 24, 333–379. Amherst, MA: Graduate Linguistic Student Association.
- 1995a, Prosodic morphology. In John Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- 1995b, Faithfulness and reduplicative identity. In Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, eds *University of Massachusetts occasional papers in linguistics* 18: *Papers in optimality theory*. Amherst, MA: Graduate Linguistic Student Association.
- McDonough, Joyce M., 1995, Gemination and the prosodic enhancement strategy. In Jill N. Beckman, ed. *Proceedings of the North East Linguistic Society* 25, 347–360. Pennsylvania: University of Pennsylvania.

- Merchant, Jason, 1994, German fricative assimilation, ambisyllabicity, and noncrisp alignment. In Jason Merchant, Jaye Padgett and Rachel Walker, eds *Phonology at Santa Cruz*, vol. 3. Santa Cruz: University of California, Santa Cruz.
- Mester, R. Armin, 1986, Studies in tier structure. PhD dissertation, University of Massachusetts, Amherst.
- Mohanan, K.P., 1982, Lexical phonology. PhD dissertation, MIT. Distributed by Indiana University Linguistics Club.
- 1995, The organization of the grammar. In John A. Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Mutaka, Ngessimo and Larry Hyman, 1990, Syllables and morpheme integrity in Kinande reduplication. *Phonology* 7:73–119.
- Myers, Scott, 1993, OCP effects in optimality theory. MS, University of Texas, Austin.
- Nespor, Marina and Irene Vogel, 1986, *Prosodic phonology*. Dordrecht: Foris.
- Nik Safiah Karim, Farid M. Onn and Hashim H.j. Musa, 1989, *Tatabahasa dewan Jilid 2: perkataan*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Odden, David and Mary Odden, 1985, Ordered reduplication in Kihehe. *Linguistic Inquiry* 16:497–503.
- Odden, David, 1988, AntiAntigemination and the OCP. *Linguistic Inquiry* 19:451–475.
- Padgett, Jaye, 1991, OCP subsidiary features. In *Proceedings of the North-East Linguistics Society* 22. Amherst: Graduate Linguistic Student Association.
- 1994, Stricture and nasal place assimilation. *Natural Language and Linguistic Theory* 12:465–513.
- Paradis, Carole, 1988–89, On constraint and repair strategies. *The Linguistic Review* 6:71–97.
- Pater, Joe, 1999, Austronesian nasal substitution and other NÇ effects. In René Kager, Harry van der Hulst and Wim Zonneveld, eds *The prosody–morphology interface*. Cambridge: Cambridge University Press.
- Piggott, Glyne, 1992, Variability in feature dependency: the case of nasality. *Natural Language and Linguistic Theory* 10:33–77.
- Prentice, D.J., 1971, *The Murut languages of Sabah*. Canberra: Pacific Linguistics.
- 1987, Malay (Indonesian and Malaysian). In Bernard Comrie, ed. *The world's major languages*. London: Croom Helm.
- Prince, Alan M. and Paul Smolensky, 1993, Optimality theory: constraint interaction in generative grammar. MS, Rutgers University, New Brunswick, and University of Colorado, Boulder. [To appear, Cambridge, MA: MIT Press.]
- Rice, Keren, 1993, A reexamination of the feature [Sonorant]: the status of 'sonorant obstruent'. *Language* 69:308–344.
- Rice, Keren and Peter Avery, 1989, On the interaction between sonorancy and voicing. *Toronto working papers in linguistics* 10:65–82.
- Roca, Iggy, 1991, Stress and syllables in Spanish. In H. Campos and F. Martínez-Gil, eds *Current studies in Spanish linguistics*, 599–635. Washington, DC: Georgetown University Press.
- 1992, On the source of word phonology. *Phonology* 9:267–287.
- 1994, *Generative phonology*. London: Routledge.
- 1997a, There are no "glides", at least in Spanish: an optimality account. *Probus* 9:233–265.



- 1997b, Derivations or constraints, or derivations and constraints? In Iggy Roca, ed. *Derivations and constraints in phonology*. Oxford: Clarendon Press.
- Rosenthal, Samuel, 1989, The phonology of nasal–obstruent sequences. MA thesis, McGill University.
- 1994, Vowel/glide alternation in a theory of constraint interaction. PhD dissertation, University of Massachusetts, Amherst.
- Sagey, Elizabeth, 1986, The representation of features and relations in non-linear phonology. PhD dissertation, MIT. (Published in 1990. New York: Garland.)
- Schein, Barry and Donca Steriade, 1986, On geminates. *Linguistic Inquiry* 17:691–744.
- Schindwein, Deborah, 1991, Reduplication in lexical phonology: Javanese plural reduplication. *The Linguistic Review* 8:97–106.
- Scobbie, J., 1992, Towards declarative phonology. *Edinburgh working papers in cognitive science* 7:1–26.
- Selkirk, Elisabeth, 1980, The role of prosodic categories in English word stress. *Linguistic Inquiry* 11:563–605.
- 1982, Syllables. In H. van der Hulst and N. Smith, eds *The structure of phonological representation*, vol. 2, 337–383. Dordrecht: Foris.
- 1984, On the major class features and syllable. In Mark Aronoff and Richard T. Oerhle, eds *Language sound structure*. Cambridge, MA: MIT Press.
- Sezer, E., 1986, An autosegmental analysis of compensatory lengthening in Turkish. In L. Wetzels and E. Sezer, eds *Studies in compensatory lengthening*. Dordrecht: Foris.
- Spencer, A., 1993, The optimal way to syllabify Chukchee. Talk presented at Rutgers Optimality Workshop I, Rutgers University, New Brunswick, NJ.
- Steriade, Donca, 1982, Greek prosodies and the nature of syllabification. PhD dissertation, MIT.
- 1988, Reduplication and syllable transfer in Sanskrit and elsewhere. *Phonology* 5:73–155.
- 1995, Underspecification and markedness. In John Goldsmith, ed. *The handbook of phonological theory*. Oxford: Basil Blackwell.
- Teoh Boon Seong, 1988, Aspects of Malay phonology revisited: a non-linear approach. PhD dissertation, University of Illinois at Urbana-Champaign.
- 1989a, Sistem vokalik bahasa Melayu: satu pemerian autosegmental. *Jurnal Dewan Bahasa* 33(6):447–461.
- 1989b, Syarat koda suku kata dalam bahasa Melayu. *Jurnal Dewan Bahasa* 33(11): 843–850.
- 1990, Pola suku kata dasar dalam bahasa Malaysia. *Jurnal Dewan Bahasa* 34(12): 904–918.
- 1994, *The sound system of Malay revisited*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Thorburn, Rachel, 1995, Glide epenthesis. MS. University of Massachusetts, Amherst.
- Thráinsson, H., 1978, On the phonology of Icelandic preaspiration. *Nordic Journal of Linguistic* 1:3–54.
- Trigo, Rosario L., 1991, On pharynx–larynx interactions. *Phonology* 8:113–136.
- Urbanczyk, Suzanne, 1995, Double reduplication in parallel. In Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, eds *University of Massachusetts occasional*

- papers in linguistics* 18: *Papers in optimality theory*. Amherst, MA: Graduate Linguistic Student Association.
- Wetzels, L., 1986, Phonological timing in Ancient Greek. In L. Wetzels and E. Sezer, eds *Studies in compensatory lengthening*. Dordrecht: Foris.
- Wilbur, Ronnie, 1973a, The phonology of reduplication. PhD dissertation, University of Illinois, Urbana-Champaign. Distributed by Indiana University Linguistics Club.
- 1973b, Reduplication and rule ordering. In *Papers from the Ninth Regional Meeting of the Chicago Linguistic Society*, 679–687. Chicago: Chicago Linguistic Society.
- 1973c, The identity constraint: an explanation of the irregular behaviour of some exceptional reduplicated forms. *Studies in the Linguistic Sciences* 3(1):143–154.
- Yip, Moira, 1982, Reduplication and CV skeleta in Chinese secret languages. *Linguistic Inquiry* 13:637–662.
- 1988, The obligatory contour principle and phonological rules: a loss of identity. *Linguistic Inquiry* 19:65–100.
- 1989, Feature geometry and co-occurrence restrictions. *Phonology* 6:349–374.
- 1992, Reduplication with fixed melodic material. In Kimberley Broderick, ed. *Proceedings of North East Linguistic Society* 22. Amherst, MA: Graduate Linguistic Student Association.
- Yunus Maris, 1980 [1966], *The Malay sound system*. Kuala Lumpur: Fajar Bakti.
- Zahara Buang, 1966, Loghat Melayu Johor. MA thesis, University of Malaya.
- Zaharani Ahmad, 1991, *The phonology and morphology of the Perak dialect*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- 1993, *Fonologi generatif: teori dan penerapan*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Zainal Abidin Ahmad (Za'ba), 1964, *Pelita bahasa Melayu penggal I: permulaan nahu Melayu*. Kuala Lumpur: Dewan Bahasa dan Pustaka.

